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# PLANNING MORE JOBS FOR MORE PEOPLE

LAST OCTOBER when chemical industry laid before President Hoover the M.C.A. plan for spreading employment through the use of the six-hour shift, its management was roundly applauded for constructive foresight. Today, according to a most recent survey by the National Industrial Conference Board, at least 50 per cent of all American business and industrial firms have reduced the hours-per-man or are applying the five-day or shorter work week. There is, of course, little occasion for pride in having led the way in what might overwise have proved a disastrous retreat; but we can strengthen our position for the future and assist in making permanent the real gains that have already been accomplished.

The idea of spreading employment has a more fundamental significance than most emergency measures that have been tried in this depression. The whole of our industrial history reflects the trend toward fewer hours for the man and more for the machine. There is no reason for believing that that trend will not continue. In fact the inevitable progress of science and invention has always resulted in increased output per worker. To keep abreast of that progress without unduly expanding total production, we have gone from the twelve-, to the ten-, then to the eight- and seven-hour day. Now we face the next step and as an entire nation we are asked to subscribe to some broad plan for reduced hours or the five-day week.

The principal factors that stand in the way of this plan are purely selfish and often short-sighted. It is only natural that the worker should object to paying all of the cost out of his wages, which have already been seriously reduced. A large part must be borne by the executives and the stockholders. Within competitive groups some way must be found to prevent unfair exploitation of labor—although such practices eventually correct themselves. The plant with obsolete processes and equipment that must work longer hours at lower pay will inevitably pass out of the picture. Modernization of plant and of labor policy go forward together. In fact, the industries that have been most successful in adapting themselves to present conditions are those in which there has been no cessation in the development of more efficient methods and machinery.

The ingenious New Hampshire plan, which has been proposed by the New England Council for national adoption, has much in its favor. It combines the shorter working week with flexibility in the number of people to be re-employed, in the arrangement of hours, methods of payment, and provision for future development. Whether it is widely applicable or not, however, it is at least worthy of thoughtful study by all of the associations representing employers of labor in the process industries. Any plan that can be adopted on a nation-wide basis is bound to bring permanent as well as temporary improvement.

# EDITORIALS

## Words of Comfort But Also of Caution

EVERYWHERE we hear and read of a change in "business sentiment." Apparently all over the country people are revolting against the extreme pessimism of recent months. But to substitute extreme optimism, to plunge from the depths of fear to the heights of hope, is not only futile but dangerous, if it is to lead merely to another disappointment.

Even if the present surge of the stock market be purely psychological, nevertheless here and there are a few encouraging developments of a more substantial character. Commodity prices for July show the largest monthly gain for the present year. Some notable examples of modernization are to be seen. The largest maker of glass-lined and steel equipment celebrated his fiftieth anniversary by spending a cool quarter of a million in completely rebuilding and enlargement of plant. A leading solvents manufacturer installs 15 new fermenters. The best known milk chocolate industry, so it is reported, is shortly to be rebuilt to the extent of $6,000,000. The petroleum industry, better off than at any other time during the past three years, is again investing in new and more efficient processes and equipment. So, after all, there is some reason for feeling a little better in chemical industry. Our progress is safe as long as we follow Dr. Haney's advice to "stick to the facts and avoid a false sentiment of buoyancy."

## Why Exhibit at The Chemical Show?

JUST NOW this question is very much in the mind of more than one manufacturer of process equipment. What, he is asking himself, are the purposes of the exhibit? What are all the factors that must be considered if, as an exhibitor, he is to derive the most profit from his efforts, at the same time contributing most to the advancement of chemical industry?

Selling is very properly the underlying motive for an exhibit. For this reason the costs of such an effort are customarily charged to sales expense. Every exhibitor hopes that what he displays may attract buyers at the moment and be potent in influencing purchasing in the future.

The exhibit provides an unequaled stage for the new product. It is the setting with all of the advantages of expert publicity and an expectant audience of consultants, buyers, and users. The new thing of merit, skillfully announced in advance, finds a satisfying reception.

But there is yet another purpose in the exhibit. It is a strange mixture of self-interest and a desire to aid in the advance of the whole industry. It is a conscious effort to elevate the industry to a place of dignity and importance in the minds of the public. The exhibitor takes pride in being a part of a dynamic, resourceful, progressive group which, through self-improvement, also performs a public service.

From its beginning the Chemical Exposition has been activated by this very motive. In those earliest days, manufacturers, not to mention the public, needed to be convinced that the chemical industry could develop in the United States. They doubted if the equipment makers could be depended upon to supply the necessary machinery—or if the required raw materials would be forthcoming. The exhibit served to answer such doubts and to impart new courage. Subsequent exhibits indicated the amazingly rapid progress of the post-war decade. People began to believe in the American chemical industry and to be proud of it.

There is still need to create and to hold public interest and support. There is still the necessity for the individual exhibitors to contribute thus to the advance of the industry as a whole. Such efforts can be made without sacrificing self interest. Indeed, in a broad sense, it is the most enlightened form of self interest.

## Ballyhooing Science For Popular Consumption

NOBODY can rightfully deny that scientific achievements, even relatively unimportant ones, are often fit grist for the newspaper mill, for in a country where popular magazines with a scientific bent can count their readers in millions, there is a large and continuous demand for scientific "copy." Nevertheless, it must be recognized that there is copy that is suitable and other copy that is not; that there are ways that are proper for the presentation of technical news for the lay press, and other ways that decidedly are not. When the news is intended only as propaganda and must be served up in blatant and attention-catching style to make it acceptable to the press, no conceivable rationalization can justify either its presentation or its use.

If one would learn the ways that scientific news can be offered to the non-technical reader in a manner that is interesting, accurate and restrained, he could not do better than to study the style that has been adopted by the two large electrical manufacturers for the hundreds of news releases they issue during the course of a year. Not only do many of these "make the front page," but they make good reading for the lay and technical reader alike. But if he would learn what to avoid, he would do equally well in examining some of the—fortunately few—releases that have erupted in recent months from one of our most eminent technical organizations. In a case in point, this organization's publicity medium seized on two papers which in themselves were quite above reproach, making no pretenses to being what they were not. But as the release was worded, and as it was published in the daily press, wonderful things, redounding to the eternal credit of the organization, were about to come to pass. Under the suggested title of the release, "Chemists Rid City Smoke of Poison Gas," it was given out that discoveries announced by the organization "promised to free cities from the danger of sulphur

dioxide, the noxious gas from which the smoke problem chiefly arises." And furthermore, that one of the two discoveries, a sensitive test for atmospheric sulphuric dioxide, had minimized such sulphur dioxide hazards as the Meuse Valley disaster of 1930!

That there is never any excuse for exaggeration, sensationalism and unwarranted statements in the popular reporting of scientific achievements is thoroughly recognized in the code of ethics of another organization, the American Institute of Chemical Engineers. That there is never any excuse for attempting to derive favorable publicity for an organization from a form of reporting that can only give a totally false impression to the uninitiated, should be self-evident. Decency aside, it seems to us that the moral of the fable about "The Boy Who Cried Wolf" has something to do with the present case.

## Changing Habits In Nitrogen Usage

AMMONIA nitrogen has supplanted nitrate nitrogen in agricultural use this year to a most unexpected degree. Will this change in the farmer's habit of fertilizer use have long continuing and far-reaching consequences? The question is at least worthy of consideration by several divisions of chemical industry.

At the beginning of the present season of fertilizer application the price of ammonium sulphate was so much lower than Chilean nitrate that the farmer could buy 50 to 100 per cent more nitrogen per dollar in this form. The results were promptly apparent. Consumption of nitrogen in the form of ammonia or ammonium sulphate remained within 10 or 15 per cent of the peak consumption in the best previous fertilizer year, despite the nearly 40-per cent decline in total nitrogen usage. In other words, the farmer appreciated the opportunity offered by ammonia for economy in his nitrogen purchases.

The future significance of this change for a single season cannot be judged altogether clearly at this time. It is important, however, that byproduct-ammonia producers of the coke industry, chemical manufacturers of synthetic ammonia and other nitrogen products, and fertilizer manufacturers make an immediate inquiry on this point. It is essential to determine whether the farmers who have used so much more ammonia nitrogen than nitrate nitrogen are satisfied with the results of their change. If not, corrective measures should be found.

Hitherto the farmer has appeared to accept the long-continued thesis of Chilean nitrate marketers, i.e., that crops thrive best on nitrate nitrogen. But the generalization has never been true in a broad sense. Ammonia nitrogen for most crops, soils, and seasons is almost, if not quite, as good as nitrate nitrogen. Under some conditions, notably in warm, wet soils, it is actually more efficient than nitrate. Correction of soil acidity induced by the use of ammonia nitrogen is cheaply accomplished with limestone. On the average, therefore, it has always been true that the farmer should pay not over 10 per cent more for a pound of nitrogen in the one form than in the other.

On page 467 of this issue of *Chem. & Met.* are statistical evidence of the importance of this problem. Here there is space only to summarize some of the major facts:

One immediate consequence has been an almost total collapse of natural nitrate sales. But for reasons best known to the bankers, this has not broken the prices. Imports of sodium nitrate for the first six months of this year are only 12 per cent of 1931 and only 11 per cent of 1930; and the apparent use of natural nitrate for fertilizer in the recent season has been very low. In the calendar year 1931 it is estimated that only a quarter as much natural nitrate was used as fertilizer as during 1929, and apparently in 1932 the usage will be still lower.

There are unusually large stocks of sodium nitrate in the United States at this time—the quantity now on hand is estimated to be in excess of 300,000 long tons. This is at least a year's and perhaps two years' consumption for fertilizer usage according to the rates now prevalent. Unfortunately for the bankers, a large part of this nitrate is reported to have been used as collateral for loans.

During recent negotiations in Europe to establish a nitrogen cartel Chile sent its ultimatum that it must have a generous quota in certain markets and an adequate price. The penalty implied for unwillingness to accept was the threat to dump accumulated world stocks and thus break the world price for nitrogen. Although other countries, Germany for example, might have joined in the dumping program, the threat was not one which could be altogether ignored. The terms agreed on by the conference are not yet known but it is reported that the world price level for nitrate nitrogen is to be "maintained," despite a much lower price level for ammonia products. One is led to wonder, in view of this situation, whether we may not find elsewhere in the world the tendency for large substitution, just as it has occurred in the United States during the past year. Potential world supplies of both ammonia compounds and nitrate are largely in excess of probable world consumption. Hence forecasting as to price levels is more than hazardous.

From the standpoint of American industry, the important thing is to establish upon the most certain basis the permanence of the substitution of ammonia nitrogen for nitrate nitrogen in the fertilizer practice of American agriculture. The fertilizer industry uses ammonia compounds rather than nitrate in mixed goods and sells many tons per year of ammonium sulphate for separate soil application. Hence it, as well as the ammonia producers, may gain significant advantages and therefore should actively cooperate with chemical and byproduct-coke interests in supporting the trend to ammonia.

**One of the large nitrate oficinas, where iodine is a byproduct**

*Photos courtesy Iodine Educational Bureau*

# FORTUNES AND MISFORTUNES

DURING the past year, the situation of Chilean iodine has changed radically, though it is doubtful if the industry itself has read the true significance of events. The monopoly, at least so far as high-priced iodine at $4 a pound is concerned, has been broken, and it has been definitely established that the United States has potential sources of production that can, if required, produce the entire American consumption. The figures tell the story: the world's consumption of iodine is approximately 2,000,000 lb., of which Chile produced about 70 per cent; the average consumption of the U. S. is about 30 per cent of this total. There were months in 1931 when the American production, of three companies in four plants, reached 30,000 lb. a month and could have been maintained had sales held up. The important fact is that the oil fields of the U. S. could produce 1,000,000 lb. yearly if the incentive of high price remained. In tardy recognition, perhaps, of this development the price of Chilean iodine recently was reduced to $6.40 a kilogram, or a few cents under $3 a pound.

### Manufacture in Chile

Before proceeding to comment on the situation that exists it will be well briefly to state the main facts of iodine technology. Iodine is contained in Chilean "caliche," the nitrate ore, in the form of iodates occurring as the minerals Dietzite, a calcium iodo-chromate, and Lautarite, a calcium iodate, although it also probably occurs in some ores as iodates of sodium and potassium. Contrary to statements in the literature that it occurs as iodide, the writer has never seen a sample of caliche containing iodide. This is an error very likely caused by the fact that on grinding caliche samples in disk crushers part of the iodate is reduced to iodide. The average content of iodine of all pampas is 0.06 per cent, the limits being about 0.01 and 0.10 per cent with exceptions running higher. The iodate gradually builds up in the mother liquors of the nitrate plant to a concentration of 2 to 15 grams per liter, 5 to 8 grams per liter being quite usual.

The old method of manufacture, still used to a large extent, is to precipitate the iodine with a solution of sodium bisulphite. This is made in the plant by passing sulphur dioxide gas through a solution of sodium carbonate, which is produced by burning together coal and sodium nitrate. The precipitated iodine is filtered, washed, pressed into cakes, and sublimed from an iron retort into sewer-pipe condensers. It is barreled in kegs holding about 60 kg. which are sewn in raw hide to withstand handling and shipping. The quality of the finished product, according to the regulations of the Iodine Association, must not be under 99 per cent nor have an acidity of more than 0.10 per cent calculated as sulphuric acid. To be on the safe side much of the iodine runs 99.5 per cent or better.

During the past ten years the following precipitation methods have come into use: (1) By thiosulphate and sulphuric acid, (2) by direct gas, passing sulphur dioxide gas into the mother liquor, (3) by imported bisulphite. Variations of these systems, such as using acid and bisulphite, acid and direct gas, gas and bisulphite, are used according to circumstances. In plants having a high borate content in the mother liquor the operation is hurried by neutralizing with sulphuric acid, in exceptional cases making boric acid as a byproduct. Whichever system is used is determined largely by the class of iodine house available, as many have been constructed merely to meet quota requirements of the Association. The cheapest house can be constructed for the "hypo" and acid process; but the cheapest iodine can be made by

the direct gas method, by which much of the iodine has been produced during the past eight years. An iodine house for nitrate plants producing 3,000 to 12,000 tons of nitrate monthly will cost $10,000 to $30,000.

The recovery of iodine from the mother liquor in a well-regulated iodine house will be over 80 per cent. This represents a recovery of only about 30 per cent from the ore, due to the incomplete conversion of the iodine minerals into sodium iodate during lixiviation. In iodine trials (special three months runs to fix the quota according to the rules of the Association), where it was suitable to subordinate other operating factors to securing the maximum iodine production, better recoveries than that have been secured.

### Manufacture in the United States

The source of iodine produced in this country is the brine from oil wells. The waters containing iodine (not

# IN IODINE

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all do) will vary from 0.01 to 0.09 g. per liter, most of those in actual use not being over 0.05 g. per liter, with the iodine in the form of iodide. To date the two processes most successfully operated have been (1) the activated char process and (2) the silver process.

The activated char process consists essentially of the following steps: Liberation of the iodine by sulphuric acid and nitrite, or by other means; adsorption on activated char; lixiviation of the char by caustic or other chemicals to form a concentrated solution of iodide; precipitation of the iodine from this solution; sublimation of the crude iodine. The silver process is based on the precipitation of silver iodide and the recovery of the iodine from this precipitate, the silver of course being recovered for re-use.

Many other processes have been experimented with on a greater or less industrial scale, including:

(1) The Turrentine process which consists in "blowing out" the liberated iodine and absorbing in a solvent.
(2) Precipitation by mercurous salts.
(3) Precipitation by cuprous salts.
(4) Separation of the liberated iodine by solution in a solvent immiscible with water, such as kerosene.

At this stage of the industry it cannot be said that any one process has proved itself to the exclusion of all others. Much depends on the type of water being treated and the proper choice of methods to fit the particular water. It can be said, however, that there has been a progressive improvement in operation, with a resultant lowering of costs. There is still a large field for investigation and development of new, and refinement of old, methods.

### Other Iodine Sources Far-Flung

Although there are no data available in recent years on the total production of iodine from seaweed in Great Britain, France, and Norway, there is reason to believe it is a total of not less than 100 tons a year. The Japanese seaweed iodine production has fluctuated considerably, from a maximum of about 150 tons yearly during the War to a normal average of about 60 tons. The production in Java from artesian waters has shown a gradual increase to possibly 80 tons yearly. A few tons have also been produced in Italy from mineral waters.

If the plans of the Soviet for iodine production, news of which has appeared in the press, should materialize, Russia will soon be the most important producer after Chile. According to information in *The Chemical Trade Journal* this production is to reach 240 tons during the present year. Reference will be made later to this possibility.

The general belief that the world is dependent solely on Chile for its iodine supply is erroneous. The following known sources outside of Chile exist today:

| | Possible Production | Source |
|---|---|---|
| Europe | 140 tons a year | seaweed |
| Japan | 150 tons a year | seaweed |
| Java | 80 tons a year | artesian |
| U. S. | 500 tons a year | oil well |
| Russia | 240 (?) tons a year | seaweed and oil well |
| Total | 1,110 tons or 2,220,000 lb. a year. | |

By no means is it meant to be understood that the above represents present plant capacity. Europe, Japan, and Java, can probably produce the quantities noted; the United States has present plant capacity of about 180 tons; the Russian plant capacity is unknown but may be 100 tons. There are also other similar sources in other parts of the world undeveloped. Much of this potential capacity would require a price of $3.50 to $4 per lb. and an assured market to bring it into production. It is the limited market and the threat that Chilean iodine can be sold for $1 per lb. that has prevented production from other sources, which could only result in price cutting and the final elimination of all producers except the Chilean. The Chilean policy has been to make sales agreements with competitors and maintain prices, but it appears that this policy can no longer be continued.

### Economic Potentialities in Chile

As iodine is produced in Chile as a byproduct of the nitrate industry, its cost as shown on the balance sheets of various plants is influenced, as usually happens with a byproduct, by the method of accounting. There is however no secret about the matter and definite figures can be given and the cost established very closely. An absolutely exact cost cannot be made because of certain factors impossible to calculate accurately, as will be explained.

The ordinary items in the cost of manufacture of iodine,—labor, chemicals, supplies, power, repairs, etc. —are of course susceptible of exact control and vary within rather narrow limits with the system of manufacture used. However, as the iodine is recovered from the

mother liquor of the nitrate plant, this liquor then being returned to the nitrate cycle after the iodine has been removed, it will be seen that the two manufacturing operations are very closely connected. One operation affects the other to greater or less extent, injecting into the consideration of the cost the following factors which cannot be accurately estimated:

(1) The liquors returning from the iodine plant sometimes cause deterioration of the nitrate plant due to the fact that, unless very carefully controlled, free iodine is given off in the nitrate plant. The amount of this damage to the tanks, pipe lines, pumps, etc., cannot be estimated with accuracy. Some plants make no charge at all for this item; others have been accustomed to make a fixed charge of as high as $0.12 a lb. of iodine produced. It is the writer's experience that in a properly controlled iodine plant this item can be reduced to zero. The custom however of intermittent operation of iodine plants, which is a direct result of the rules of the Iodine Association, does not tend to stabilize operations. As an iodine plant operates only three to six months in a period of three years, when it is required to replenish stocks, the continually changing difficulties of operation have hardly been solved and remedied when the operation of the plant is stopped.

(2) In the manufacture of iodine a certain amount of water enters the nitrate cycle through the addition of reagents in solution to the mother liquor. Although the effect of this slight dilution of the mother liquor on the nitrate recovery is not very great it does nevertheless introduce another factor difficult to estimate. According to the system of iodine manufacture used, and under the very worst conditions, this item can amount to $0.05 a lb. of iodine; usually it does not amount to more than $0.02.

(3) Under the old system of "iodine trials" by which a plant optionally could appeal from the assigned quota by a 90-day intensive "run" of the iodine house, it often became advisable to change the operation in the nitrate plant in a manner prejudicial to the nitrate recovery in order to improve the iodine recovery. Thus the content of iodate, as also borate, in the mother liquor could be changed somewhat by changes in the nitrate cycle, although often such a change sacrificed in a small degree the nitrate to the iodine recovery. Instances have come under the writer's attention where this item, properly calculated, could represent $0.05 a lb. of iodine.

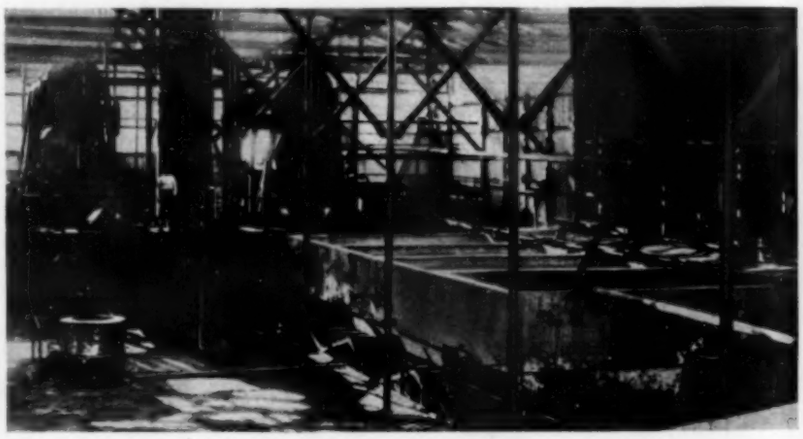
Taking all these factors into account, assuming good operation and recoveries under normal practice, making proper charges for amortization of plant, repairs, administration, port charges, etc., iodine can be placed on board in Chilean port at a cost of $0.30 to $0.50 a lb. depending on the plant of origin. Including freight, insurance, contributions to the Association, storage, selling expense, etc., the cost delivered to the consumer can be $0.40 to $0.60 per lb. That a considerable margin for improvement still exists will be made clear.

An export duty of approximately $0.32 a lb. was formerly paid to the Chilean government. By decree of April 30, 1931, this tax was removed for those companies associated with the Cosach, which applies practically to the entire production.

### Amount Producible in Chile

The amount of iodine that Chile can produce depends on the nitrate production. With normal sales of nitrate, if these are ever reached again, the industry easily can produce six times its average sales of iodine.

On the other hand either of the two large Guggenheim plants, Maria Elena or Pedro de Valdivia, could produce the entire yearly average of Chilean iodine exports of 700 tons. Or the old Lautaro Nitrate Co. alone, before its incorporation into the Cosach, could easily have produced the entire world consumption. Even if the total sales of Chilean nitrate never again reached 500,000 tons a year, as against normal sales of 2,500,000 tons, it can be said with certainty that Chile could still produce the entire world consumption of iodine.



**Iodine house in a Chilean nitrate oficina, with precipitating tanks at right**

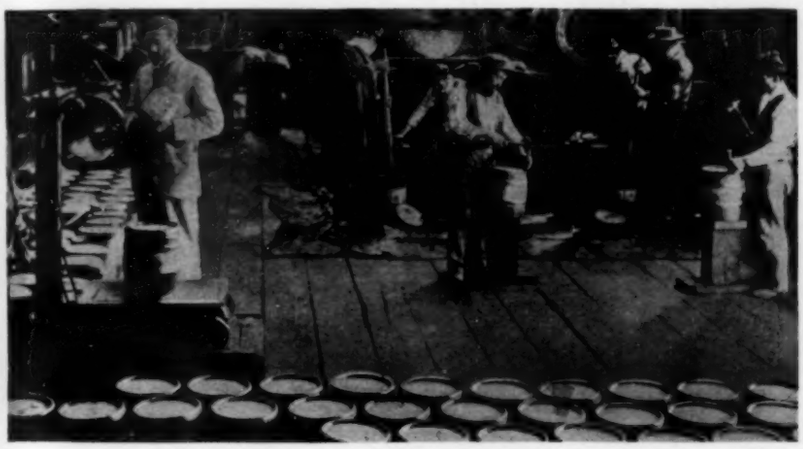
By technical improvements and a rational plan of manufacture centralized in a few good plants operating continuously, recoveries can be improved and costs lowered. It is well within reason that Chilean iodine could be placed in the United States or Europe at a cost of not over $0.25 a lb. There are many possibilities that a systematic plan of development would in the end work for the good of Chile, the nitrate industry, and the increased use of this unique element. There is no good reason, for example, why potassium and sodium iodides, whose use accounts for 80 per cent of all iodine consumed, should not be manufactured directly at the iodine plant in Chile. In this way the recovery of iodine could be greatly improved, costs lowered, and the product be distributed with the elimination of several intermediaries.

### Cost of Non-Chilean Iodine

Seaweed iodine always has been and will be expensive iodine. Although little information is available on its cost of production, $2 to $3 a lb. probably expresses the limits. When produced from oil well brines the cost of

iodine is less than that from seaweed, though it is still high-cost iodine. By technical developments and experience great improvements in the cost have been made and it is certain that great reductions will be achieved in the future if the industry survives long enough. The cost, judged by that of Chilean iodine, is very high. The policy of the Chilean industry undoubtedly will be the determining factor in its development and cost reductions. Consideration of the technology would indicate that a cost of $1 a lb. can be hoped for in certain cases, though such a figure is of course much lower than the results secured to date. The iodine produced in Java is also in the category of high-cost iodine as compared with Chilean iodine, its cost probably being about the same as from oil-well brine.

To the nitrate manufacturer, iodine has always been a "llapa," a "handout," easy money. Compared with the nitrate business it was of minor importance but gratefully received. The enormous unit profit on iodine of almost $3 a lb., when distributed over the tonnage of nitrate sold, represented only about $1.20 a ton. It has been an article whose consumption remained practically stationary, due to the fact that its greatest use was in medicine. To what extent high price and stationary consumption are cause and effect is very difficult to say. But the general feeling was that it was better to accept a profit of $3 a lb. on 70 per cent of the world's consumption than a profit of $1 a lb. on the total consumption. The former meant $4,000,000 per year, the latter $2,000,000, with doubts of an increase in consumption.



**Iodine being scraped from condenser pipes into kegs and prepared for shipment within leather covers**

It has been mentioned above that profit from iodine represents $1.20 per ton of nitrate, by the usual methods of accounting. Although the prospect for Chilean nitrate appears dark, the same cannot be said of iodine. On decreased nitrate sales the profit from iodine becomes of increased importance. Assuming that a $1 profit a lb. on iodine would return to Chile 100 per cent of all iodine sales, and with nitrate sales at 1,000,000 tons yearly, the profit from iodine then represents $2 per ton of nitrate; on sales of 500,000 tons it represents $4 per ton.

The Iodine Association has of course been the directing force in Chile's iodine policy. That its policy has been for the good of Chile, or for the industry, is open to question. It is only fair to say that the Association has spent considerable sums in propaganda. One wonders however what would have been the result had the thousands of dollars scattered over the pampas in complying with the incredibly anti-economic statutes of the Association, made by the iodine producers for their own industry, been spent in scientific research for new uses for iodine, development of present known uses, and in intelligent advertising.

Fortunately, perhaps, for Chile the law permits the government to declare iodine a government monopoly whenever it sees fit. Opposed as one may be to such procedure it must be admitted that the results could not be as disastrous for Chile as some policies of the Iodine Association. Just as Chilean nitrate created its own competition, so has the Chilean iodine industry fomented the investigation and discovery of other sources until at last after many years it sees itself forced into the policy that common sense long ago indicated, merely proving once again that the policy of "all the traffic will bear" in the long run never is good business.

### International Prospects

At the present time the Iodine Association has sales agreements with all producers except the American, Japanese, and Russian. It is not believed that Russian production has as yet reached the large scale proposed. Even should the optimistic Russian figure of production quoted previously materialize it should be remembered that the part of this produced from seaweed will not be able to compete with a lower price. The very fact however of the potential Russian production and the actual American production will undoubtedly cause a still further reduction in price of Chilean iodine. It is of course a satisfaction to the United States to know that in case of war it can produce its own iodine supply, as it must also be to the Soviet. Because of these developments it seems certain that iodine will never again sell near $4 a lb. and that the tendency will be downward. At $4 a lb. in normal times iodine plants in the U. S. would spring up like mushrooms; at $3 a lb. some American and some seaweed production becomes poor business; at $2 per lb. only certain of the producing sources in the U. S. and other countries would remain in production, while Chile would have recaptured at least 90 per cent of the world's consumption.

To the Chilean government iodine must be considered both in relation to the nitrate industry and to the welfare of the country. It seems ridiculous that they should needlessly sacrifice 50 per cent of the sales. In the total budget of the Chilean government the one to two million dollars that iodine might reasonably yield is of importance. The maintenance of the monopoly to Chile also has other indirect results in employment and internal business that cannot be neglected in a country of under 4,000,000 inhabitants.

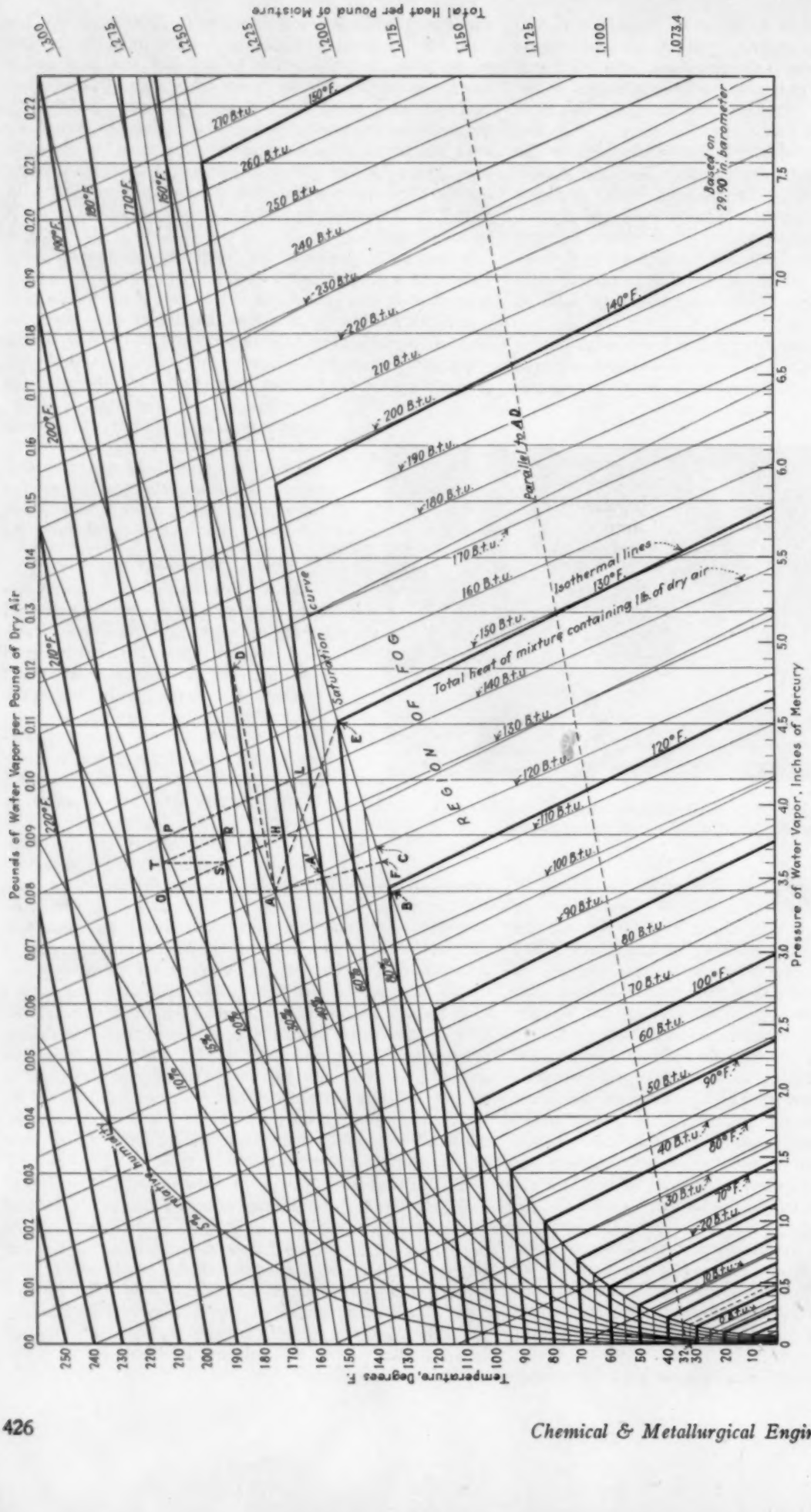



**Fig. 1—Mollier Water-Air Mixture Chart for Air-Drying Calculations**

This diagram, in its original form, is one that is well known in European engineering practice, although it has not been used extensively in the United States. Impressed with its advantages over the usual psychrometric charts for the calculation of air-drying problems, Mr. Weiselberg converted Prof. Mollier's original chart into English units, adding lines for constant relative humidity to assist those engineers who prefer to use relative rather than percentage absolute humidity. The author points out that percentage absolute humidity can be found on the chart by measuring the percentage on the proper constant-temperature line. That is, the state of air with a percentage absolute humidity of 30 and a dry-bulb temperature of 130 deg. F. will be found at 30 per cent of the linear distance from the left-hand vertical (dry air) to the saturation line.

Use of the chart does not differ materially from that of other psychrometric charts. Knowing dry- and wet-bulb temperatures, it is possible to determine all other characteristics of the air. A complete definition of the air may also be made if certain other pairs of characteristics are given, for example, dry-bulb temperature and pounds of water per pound of dry air (or dew-point temperature of the mixture); or dry bulb and relative or percentage absolute humidity; or moisture and total heat content of the mixture; or total heat content and partial vapor pressure or dew-point temperature. In the case of point *A*, for instance, a mixture with a dry bulb of 155 deg. and a relative humidity of 40 per cent will be observed to have a moisture content of 0.08 lb. per pound of dry air, a vapor pressure of 3.41 in. Hg., a dew-point temperature (*B*) of 123 deg. and a heat content of 120 B.t.u. for a quantity of mixture containing 1 lb. of dry air. (*Not* per pound of mixture, it should be noted.)

A word regarding the right marginal scale is desirable. The scale lines indicate the direction taken by any change in the state of air when there is an addition of $H_2O$ containing the indicated number of B.t.u. per pound. For example, the line representing the change from *A* to *D* is parallel to the 1,156-B.t.u. line, meaning that the change was brought about by the addition of steam at 5 lb. gage (1,156 B.t.u. per pound).

# Factors That Influence Dryer Performance

By ARNOLD WEISSELBERG

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REMOVING moisture by evaporation at atmospheric pressure with air alone supplying the heat of vaporization, commonly termed air drying, has made great forward strides in the last decade. As the requirements of the chemical industry for quality of product and efficiency and capacity of equipment grew more exacting, old methods had to be discarded. Research set in to furnish the scientific background and equipment manufacturers followed suit in applying it.

In the following I shall, as far as the restricted space permits, discuss the factors which enter into the performance of a dryer, their relations to the mechanism of drying and the improvements they suggest.

*Capacity*—By the term capacity, is understood either the pounds of moisture removed or the quantity of material dried from a given initial moisture content to a final moisture content in a unit of time. It is governed by two factors: (*a*) the holding capacity of the dryer, that is, the quantity of material accommodated by the dryer for chemical products differs from other dryers instance, if it takes a dryer 20 minutes to dry the material from its initial moisture content to a final one and the dryer holds 500 lb. of material, the capacity is 1,500 lb. per hour. With respect to holding capacity, the drier for chemical products differs from other dryers whose capacity is rated, for instance, in yards of material dried in a unit time (such as textile dryers) in that the holding capacity for one and the same dryer changes with the initial moisture content of the material. In comparing the holding capacity of two dryers for the same material it is, therefore, necessary to take the same moisture content as a basis.

*Drying Rate*—The Mollier Water-Air Mixture chart (Fig. 1) is very convenient for graphic presentation of processes involving a mixture of air and water. Referring to the chart, the air at the state designated by the point, *A*, has a dry-bulb temperature of 155 deg. F., a relative humidity of 40 per cent, contains 0.08 lb. of moisture per pound of dry air and has a heat content of 120 B.t.u. for each 1.08 lb. of mixture. *B*, at the intersection of the vertical through point *A* (constant moisture-content line) with the saturation curve, gives us the dew point at 120 deg. F., and point *C*, at the intersection of the constant heat-content line with the saturation curve, gives the wet-bulb temperature of 123 deg. F. The pressure of the vapor in the air, or partial vapor pressure (which is equal to the vapor pressure at dew-point temperature), may be read at the bottom as 3.41 in. of mercury. To find how 1 lb. of dry air and its contained moisture (state *A*) would change if 0.04 lb. of steam of 5 lb. gage pressure ($h = 1{,}156$ B.t.u.) were added to it, draw a line through *A* parallel to the line connecting the freezing point (32 deg. F.) on the scale on the extreme left with 1,156 B.t.u. on the marginal scale at the extreme right and the intersection with the 0.12 constant moisture line (at *D*) will furnish the answer.

The moisture in the wet material may be either pure liquid or contain crystalloids or colloids in solution. The pure liquid or the solution may be present as surface, capillary or hygroscopic moisture. The removal of the surface moisture will not differ from the evaporation of a film of water, except that in the case of a crystalloid solution, the vapor pressure is reduced.

*Evaporation*—The rate at which water evaporates was established by Dalton as being equal to $N(e' - e)$, where $N$ is a constant for a given set of conditions such as the character of air movement, the nature of the film separating the liquid from the atmosphere (*e.g.*, sizing, oils, chemicals), $e'$, the vapor pressure at the temperature of the liquid, and $e$, the partial pressure of the vapor in the atmosphere. Let *E* on the chart denote water having a temperature of 130 deg. F. and *A*, the condition of the air above it. If the water should maintain its temperature (through heat being supplied directly to it by radiation or conduction) and the air, its condition (through continuous replacement), the rate of evaporaiton would be proportional to the difference in vapor pressures (4.5 in. – 3.41 in.) as read at the bottom of the chart. When the air is not replaced, although the liquid continues to receive heat directly, the moisture content of the air will rise, the state of the air changing in the direction, *AE*, until it approaches saturation point, *E*, the rate of evaporation decreasing simultaneously. But if the heat supplied to the liquid should also be discontinued, all heat required for evaporation would have to come from the heat stored in the liquid, which means that the liquid would cool off. Since the heat of vaporization is about 1,000 times the specific heat, each pound of liquid will cool off 1 deg. F. for each 0.001 lb. evaporated. Evidently a film of liquid will cool off very rapidly because of the great surface exposed in comparison with the weight of water involved.

Assume that the liquid has a temperature less than that of point *C*, the wet-bulb temperature. Air of state *A* in contact with such liquid will give up more heat than it receives from the vapor (the connecting line, *AF*, will fall below the constant-heat line), thus raising the temperature of the liquid until *C* is reached. Hence, a liquid in contact with air and receiving no heat from an outside source will assume the temperature at the intersection of the saturation curve with the constant-heat

line through the point designating the state of the air, which is the wet-bulb temperature. The change in the state of the air will proceed practically immediately along the line of constant heat. The mean rate of evaporation while the air is changing from the state at $A$ to that at $A'$ will be proportional to the average vapor-pressure difference, or the average wet-bulb depression, between these two points. For small changes it will be sufficiently accurate to use the arithmetic mean; for larger changes, however, the logarithmic mean difference must be used in order to find the true average.

Suppose, now, that the moisture content of air of state $A$ is augmented through evaporation by 0.02 lb. of moisture per pound of dry air and that after this addition of moisture, the relative humidity is 60 per cent (point $L$). Suppose, further, that the maximum temperature to which the air can be heated is 192 deg. F. This can be accomplished in two steps, first heating the air to point $O$ and permitting it to come in contact with the liquid until it (the air) reaches a temperature of 150 deg. F. (point $H$) and again heating the air to point $P$ and bringing it in contact with the liquid until its temperature becomes 145 deg. F. Nothing prevents us, however, from inserting another step, $STR$, between $O$ and $P$. No more heat will be used, but the rate of evaporation will be higher since the rate of evaporation for $O$ to $S$ and $T$ to $R$ is higher than that of from $O$ to $H$. From this we can draw the important conclusion that, given a maximum temperature to which the air may be reheated, the drying rate may be increased by increasing the number of reheating cycles.

*Diffusion*—When the surface moisture has evaporated, the capillary moisture diffuses to the surface. Whether the drying rate will fall off at this point or not will depend upon the rate of diffusion as compared with the rate of evaporation of the surface moisture. With forced convection and high resistance to diffusion, the drying rate will start falling at a higher moisture content than with natural convection and low diffusion resistance. Once the drying rate falls off because of insufficient moisture diffusion to the surface, internal liquid diffusion controls the rate of drying and *the convection of heat should be regulated accordingly.*

The diffusion of liquids through solids from points of higher concentration to those of lower concentration (natural diffusion) follows the fundamental laws of heat diffusion (Sherwood, "Drying of Solids," *Ind. Eng. Chem.*, **22**, 929, p. 133) and the rate is indirectly proportional to the square of the slab thickness. In case the liquid involved is a solution, the rate of diffusion will also depend on whether the solution is colloidal or crystalloidal, since crystalloids are readily diffusible, while colloids are not.

The diffusion of capillary moisture continues at a steadily decreasing rate until the material assumes a certain moisture content depending mainly on the relative humidity of the surrounding air and, to a small extent, on the temperature. The remaining moisture is hygroscopic and, expressed in per cent of dry weight, is termed regain.

Natural diffusion, however, is a slow process. Whenever it is feasible the material should by dried with as small a thickness as possible and, if it can be disintegrated, should be reduced to the smallest permissible size and turned over during the drying so as to expose fresh surfaces. If the material must be dried in slab or cake form and it is desired to decrease the drying time, the drying process should provide forced diffusion.

*Forced Diffusion*—As an example of forced diffusion we know, for instance, that if we were able to apply heat directly to the moisture inside the material, the moisture would be driven out rapidly. This is explained, of course, by the presence of a pressure differential which is set up on account of the difference in temperature created by the supply of heat inside the material. The same end is accomplished if the reduction of the relative humidity of the surrounding air is accompanied by a lowering of its temperature. If the temperature were the same, only natural diffusion would take place. When the outside temperature is higher, diffusion will cease until the moisture inside acquires the temperature of the air, during which time the layers of material nearer the surface will overdry.

Forced diffusion follows the law of liquid flow through capillary tubes, and the rate of flow may be set equal to $\frac{\Delta p}{d}C$ in which $\Delta p$ is the pressure difference, $d$, the thickness of the material, and $C$, a coefficient which depends on the nature of the material and, also to a small extent, on the temperature. In the case of a temperature difference, the heat-flow rate may be set equal to $\frac{\Delta t}{d}K$, in which $\Delta t$ stands for the temperature difference, $d$, again for the material thickness, and $K$, for the coefficient of heat transfer. From the Water-Air Mixture chart, one can see that the vapor-pressure difference per degree F. temperature difference increases rapidly with the temperature. From this it follows that,

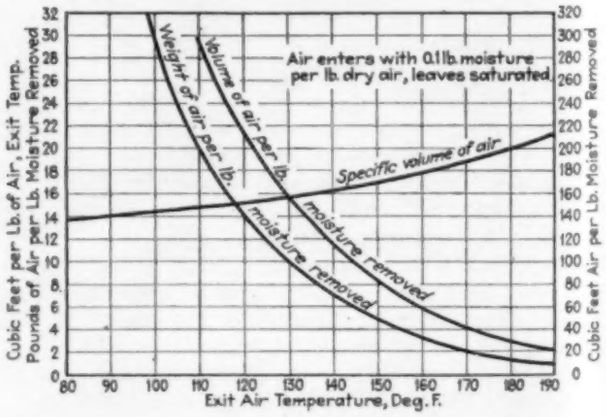
Cubic Feet per Lb. of Air, Exit Temp.
Pounds of Air per Lb. Moisture Removed
Cubic Feet Air per Lb. Moisture Removed
Exit Air Temperature, Deg. F.
Air enters with 0.1 lb. moisture per lb. dry air, leaves saturated
Weight of air per lb. moisture removed
Volume of air per lb. moisture removed
Specific volume of air

**Fig. 2—Specific volume of air, and weight and volume of air per pound of moisture removed, for various exit air temperatures**

for the same temperature difference, the diffusion rate is greater at higher temperatures while the outward heat flow remains the same. We may, therefore, surmise that in order to speed up the rate of diffusion and, consequently, the drying, it is necessary that the reduction of the relative humidity of the air (in the direction of travel of the material) be accompanied by a *reduction in temperature* and that *operating temperature be high.*

*Efficiency*—The less heat a dryer requires to evaporate

1 lb. of moisture and the less power it requires to remove the pound of moisture in a unit of time, the more efficient it is considered to be. Unless a heat equivalent is chosen for 1 lb. of moisture removed to permit giving the thermal efficiency in percentage, this efficiency is expressed in pounds of steam per pound of moisture removed or, to be more exact, in actual B.t.u. used per pound of moisture extracted. The heat input appears in the following items:

1. Heat to evaporate the moisture at the temperature at which it enters the dryer.

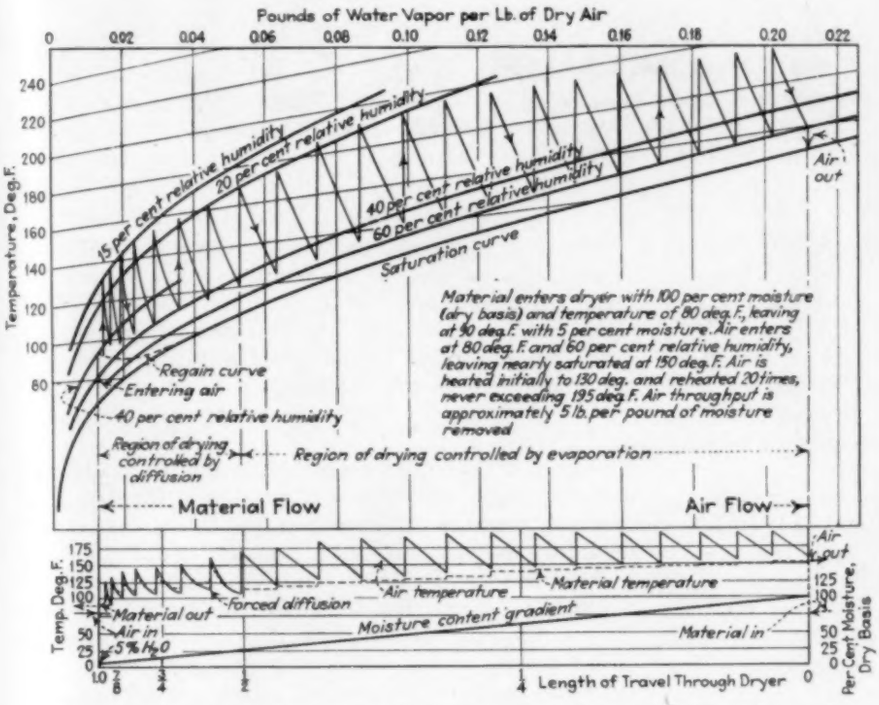
Pounds of Water Vapor per Lb. of Dry Air
Temperature, Deg. F.
15 per cent relative humidity
20 per cent relative humidity
40 per cent relative humidity
60 per cent relative humidity
Saturation curve
Air out
Material enters dryer with 100 per cent moisture (dry basis) and temperature of 80 deg. F., leaving at 90 deg. F. with 5 per cent moisture. Air enters at 80 deg. F. and 60 per cent relative humidity, leaving nearly saturated at 150 deg. F. Air is heated initially to 130 deg. and reheated 20 times, never exceeding 195 deg. F. Air throughput is approximately 5 lb. per pound of moisture removed
Regain curve
Entering air
40 per cent relative humidity
Region of drying controlled by diffusion
Region of drying controlled by evaporation
Material Flow
Air Flow
Temp. Deg. F.
Air out
Air temperature
Material temperature
Material out
Forced diffusion
Moisture content gradient
Air in
5% H2O
Material in
Per Cent Moisture, Dry Basis
Length of Travel Through Dryer

**Fig. 3—Performance of a counterflow, reheating air dryer, illustrated on a skeleton Mollier Water-Air Mixture chart; air and material temperatures and the moisture gradient of the material are shown in the lower diagram**

2. Heat to raise the temperature of the evaporated moisture from the temperature at which the moisture enters the dryer to the temperature of the exit air.

3. Heat to raise the temperature of the air entering the dryer to the exit temperature, including its initial vapor content but not including the moisture added in the course of the drying process.

4. Heat carried from the dryer with the material (including final moisture content) above the temperature at which it enters the dryer.

5. Heat loss due to radiation from the inclosure.

Item (1) is equal to the heat of vaporization at the initial temperature of the moisture in the material, which is usually the same as the room temperature or somewhat below (*e.g.*, 1,050 B.t.u. at 75 deg. F.).

Item (2) is very small in comparison with Item (1) since only 0.427 B.t.u. is required for every degree of temperature difference. Hence the extra heat consumed in evaporating the moisture at high temperatures is nominal.

Item (3) decreases as the temperature of the discharged air and its humidity increases since this lowers the number of pounds of air required to evaporate 1 lb. of moisture (see Fig. 1 and curves of Fig. 2). For instance, if the air enters at 40 per cent relative humidity and 85 deg. F., and leaves practically saturated at 150 deg. F., the heat used per pound of moisture is $5 \times 16 = 80$ B.t.u., whereas at 130 deg. F. it would be $10 \times 11 = 110$ B.t.u. Hence, for greatest economy, the air should leave the dryer as nearly saturated as possible at the highest permissible temperature as determined by such limiting factors as discoloration, coagulation, sublimation, decomposition, etc. Incidentally, the power consumption is also less at high temperature because of the smaller quantity of air that must be put through the dryer per pound of moisture removed. The quantity of air that is put through the dryer should not be confused with the air circulated within the dryer, which is a function of the heat transfer conditions.

Evidently a single-stage dryer in which the air is heated only once just before drying is started cannot be very efficient thermally unless the air is heated to extremely high temperatures. If the temperature of the heating medium is low, however, reheating must be resorted to if high thermal efficiency is desired. The greater the number of reheating cycles for a given reheating temperature, the higher the thermal efficiency at a certain drying rate.

Item (4) is small when the amount of moisture removed is large in comparison with the quantity of material dried, and is reduced to a minimum in counterflow operation if the dried material is cooled by the entering air.

Item (5) depends on the insulation of the inclosure. Since it is expressed in B.t.u. per pound of moisture removed, it also depends on the drying rate and good insulation becomes a factor of importance when the drying rate is low.

In conclusion, the performance of a dryer designed in accordance with these principles is presented graphically in Fig. 3. This dryer has a large number of reheating cycles so that high thermal efficiency may be obtained with a heat supply of low temperature. The heating elements are spaced farther apart toward the dry end of the dryer, so that the convection of heat is commensurate with the falling-off in the rate of drying. The counterflow, together with the temperature graduation of the cycles, results in forced diffusion, thus speeding up the drying. The temperatures at both the wet end and the dry end are within the assumed limits. The material is not subjected to improper drying and, provided the air is uniformly distributed over the drying surface, close control may be kept over the final moisture content, with the assurance of continued uniformity of results.

# CONCENTRATED NITRIC ACID BY DIRECT SYNTHESIS AVOIDS ABSORPTION

By GIACOMO FAUSER
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ONE of the most difficult problems which modern technique of synthetic nitrogen has had to face is the direct synthesis of nitric acid at the concentrations required by certain industries. It is known that the absorption of nitrous gases in water, at ordinary temperature and pressure, allows the yield of a nitric acid having a concentration of 55 per cent: beyond this limit the concentration does not increase, not even by making unlimited quantities of gas pass through.

By operating under pressure, or else lowering the temperature, the equilibrium is displaced and it is possible to increase the concentration of the acid, reaching a maximum of 68 per cent. But even this concentration is insufficient for a great number of industrial applications, especially for the preparation of explosives, and therefore we must have recourse to concentration.

### Traditional Concentrating Procedure

Concentration must be effected by a dehydrating agent, for 68-per cent nitric acid is an equal-boiling composition which it is not possible to concentrate by the simple action of heat. The dehydrating agent normally employed is concentrated sulphuric acid, which, at the high distillation-temperature of nitric acid, still absorbs considerable quantities of water while its vapor tension is still relatively low.

The operation is effected by mixing dilute nitric acid with three or four times its weight of 95-per cent sulphuric. This mixture is introduced in a steam-heated tower, the nitric acid distills, and after condensation an acid of 98 per cent is obtained, while the sulphuric acid, which has absorbed water, is withdrawn from the bottom of the tower and must be concentrated again.

This reconcentration is a very costly operation because the volume of sulphuric acid in circulation is considerable, the consumption of fuel is high, and the loss of sulphuric acid incurred with each reconcentration represents a further significant item. Moreover one must bear in mind that this operation requires the use of apparatus resisting the attack of both nitric and sulphuric acids at high temperatures: it must therefore be constructed in ferrosilicon or quartz, a very fragile and cumbersome material.

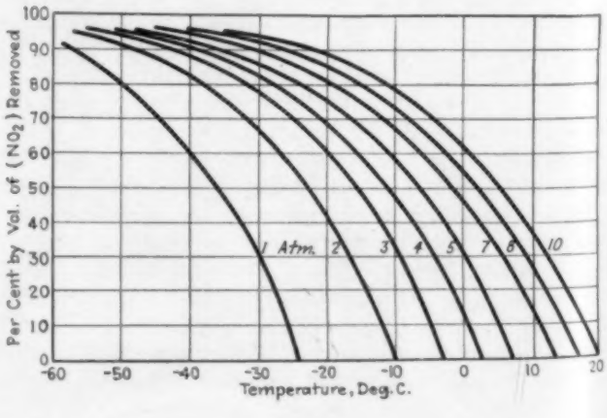
Because of these considerations, a direct method of obtaining concentrated nitric acid has been studied. A series of experiments had shown that it was possible to obtain concentrated nitric acid by making liquid nitrogen peroxide, water and oxygen react together under pressure, according to the reaction:

$$2H_2O + 2N_2O_4 + O_2 = 4HNO_3 + 18.8 \text{ Cal.}$$

Research on this equilibrium has already been published; suffice it to say here that this reaction is favored by increase in pressure and is accelerated by increase in temperature. For example, at a pressure of 50 atm. and a temperature of 15 deg. C., the formation of nitric acid requires 12 hours, but if the temperature is raised to 70 deg., the time necessary for the reaction is reduced to only 4 hours.

In the place of water it is convenient to use dilute nitric acid (60 per cent), and the reaction can be made continuous by introducing at the top of a baffle-plated tower, resistant to the pressure of 50 atm., compressed oxygen, liquid nitrogen peroxide and the dilute acid. By opportune proportioning of the dimensions of the column, so as to give a time sufficient for the reaction, it will be possible to discharge from the bottom of the tower concentrated nitric acid. The construction of a

**Fig. 1—Effect of pressure and temperature on removal of ($NO_2$) from 10 per cent gaseous mixture**



baffle-plated tower is somewhat complicated and therefore usually a simple autoclave is preferred; in this case, of course, the operation is not continuous.

For the production of 1 ton of 98 per cent nitric acid it is necessary to employ 730 kg. nitrogen peroxide, 143 kg. water, and 127 kg. oxygen. Starting with 60 per cent nitric acid, 600 kg. of nitrogen peroxide, 300 kg. of acid and 104 kg. of oxygen, corresponding to about 73 cu.m., will be required. This oxygen is often a by-product of liquid-air nitrogen or of electrolytic hydrogen, therefore if the nitric acid plant is installed near a synthetic ammonia plant, only the expense of compression (12 kw.-hr. per ton conc. acid) need be taken into account. Even if the oxygen had to be expressly produced, however, it would enter very negligibly into the cost price of acid produced. In modern air-fractioning plants, where the cost does not exceed $0.015 per cu.m., it would represent only $1.10 per ton of 100 per cent acid.

A temperature of 70 deg. C. is maintained in the autoclave by hot water circulation, and is supported by the exothermic reaction.

### Difficulties in Nitrogen Peroxide

From what has been said, it is apparent that the cost price of concentrated nitric acid depends principally on the cost of the *liquid* nitrogen peroxide necessary for the reaction. And the reason why direct synthesis of nitric acid has not yet been applied on a large scale has been the difficulty of preparing pure nitrogen peroxide up to the present.

One proposed method was to separate the nitrous oxides from ammonia oxidation gases by absorbing them in substances which, on subsequent heating, would release the nitrous gases in a pure state. But this method involves a complication in apparatus that eliminates it. Another method consists in the separation of nitrous gases by cooling, but this also entails prohibitive technical and economic difficulties. In fact, in order to separate 80 per cent of the nitrous gases coming from ammonia oxidation it would be necessary to cool them to about —50 deg. C. In this case the $N_2O_4$ is condensed in solid form, and has to be melted out; this again calls for an intermittent operation. This process was applied industrially in a few plants but has now been abandoned. The gases, coming from electric arc ovens, were cooled to very low temperatures so as to condense the $N_2O_4$, and as a cooling medium toluene was employed. Following the breakage of some equipment, a mixture of this organic liquid and nitrogen peroxide was formed, and violent explosions took place.

Finally, another method for producing pure $N_2O_4$ consists in the oxidation of ammonia by oxygen. In order to maintain the mixture below the explosive limits steam is added; the catalyzed gases are rapidly cooled so as to condense the steam with a small percentage of nitric acid, and the $N_2O_4$ is condensed by cooling down to a few degrees under zero. This process, though very simple technically, in order to be feasible economically, must count on available, free oxygen. Moreover, the conversion efficiency is relatively low and the loss of nitric acid in the condensed water also weighs unfavorably.

After a thorough study of the problem, we have succeeded in developing a process which eliminates the numerous difficulties mentioned. This method is based on the simultaneous use of pressure and cold. In order to prevent the solidification of $N_2O_4$, the nitrous gases must not be cooled under —10 deg. C.; from the curves in Fig. 1, it is seen that, at this temperature, if the gases contain about 10 per cent N $O_2$, in order to condense 80 per cent of the total, it is necessary to compress the mixture to 10 atm. This pressure requires a relatively high consumption of energy, but on the other hand allows a great reduction in the volume of absorption apparatus.

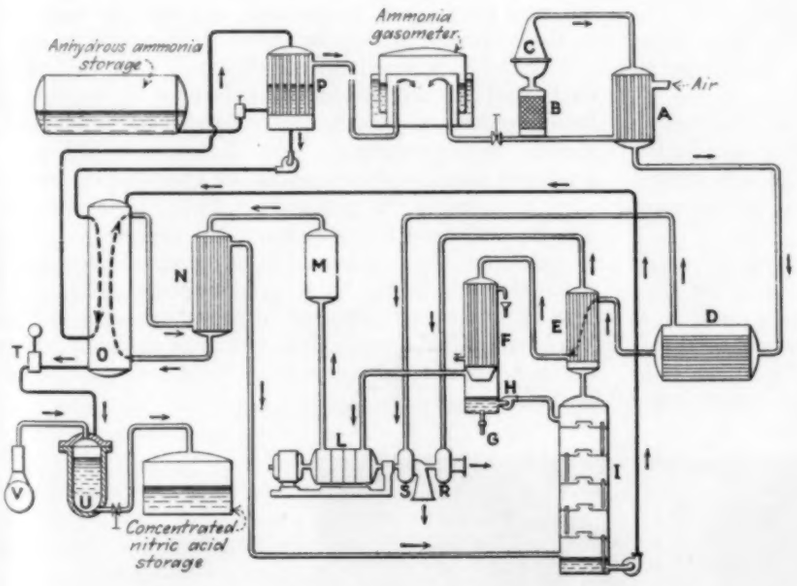



**Fig. 2—Flowsheet for production of concentrated nitric acid by Fauser process (see text below)**

### Commercial Adaptation of Process

In industrial practice the process does not offer special difficulties, because the chromium steels used are practically unattacked by nitric acid, and lend themselves to the construction of all the apparatus required. In Fig. 2 is a diagram of the process as used in commercial operation.

The air, after having been preheated in the heat exchanger *A* at the expense of the heat of the catalyzed gases, is mixed with ammonia in the mixer *B* and sent in the burner *C* where the catalytic combustion takes place. The nitrous gases, after circulating through the exchanger, pass first through a steam boiler *D* and then through a second heat exchanger *E*, designed to heat the residual gases prior to their expansion in the turbine for the recovery of energy. The water coming from the reaction, is condensed in the cooler *F*. According to the stoichiometric equation,

$$\underset{17}{NH_3} + \underset{64}{2O_2} = \underset{63}{HNO_3} + \underset{18}{H_2O}$$

on making all the condensed water react with the nitrous

gases, it would be possible to obtain an acid with a maximum concentration of 77.7 per cent. In order to reach a concentration of 98 per cent, it is necessary to eliminate two-thirds of the water of reaction by means of the tap *G* while the rest is introduced in the absorption column *I* by the pump *H*.

If the cooling of the nitrous vapors is effected very rapidly, the NO does not have time to oxidize and react with the condensed water and in such a way it is possible to reduce to negligible values the loss of nitric acid in the water which must be eliminated.

It should be observed that it is possible to condense the water of reaction without absorbing appreciable quantities of nitrous gases only when the oxidation of the ammonia is effected at atmospheric pressure. In fact, when the ammonia is oxidized at a pressure of 8-10 atm. the time interval required for the oxidation of the NO at that pressure is so brief that even when the gases are cooled with great rapidity, the condensed water always contains important percentages and possible losses of nitric acid. Again, as a consequence of the absorption of a fraction of the oxides of nitrogen in the water of reaction, the NO content of the gases decreases and so also the fraction of nitrogen peroxide which can be recovered in the liquid state.

The nitrous gases are compressed in the turbo-blower *L* to a pressure of 8 atm., and sent first into the oxidation tower *M* to attain the necessary degree of oxidation, then they pass through the cold recuperator *N* and subsequently into the condensation tower *O*. This tower is divided into a series of compartments, cooled by an unfreezable mixture, at a temperature of —10 deg. C. If the ammonia intended for oxidation is available in liquid form, the cold furnished by its evaporation in the apparatus *P* is sufficient for the cooling of the nitrous gases: if it is in the gaseous state, then it is necessary to install an ice machine.

In the top of the tower *O*, the dilute nitric acid coming from absorption, is introduced; it facilitates the condensation of the $N_2O_4$ present in the gases, and from the bottom of the column a mixture is extracted which contains a proportion of nitrogen peroxide sufficient to transform all the water of dilution into concentrated nitric acid. This proportion is reached when the percentage of $N_2O_4$ condensed corresponds to about 80 per cent of the total quantity present in the gases at the exit of the burners, which is obtained with a pressure of 10 atm. abs. and a temperature of —10 deg. C.

The gases coming out at the top of the condensation column after circulating through the exchanger *N* are sent into the absorption tower *I*, in the top of which the water of reaction is introduced. In this column the nitrous gases, which are not condensed in the column *O*, are absorbed.

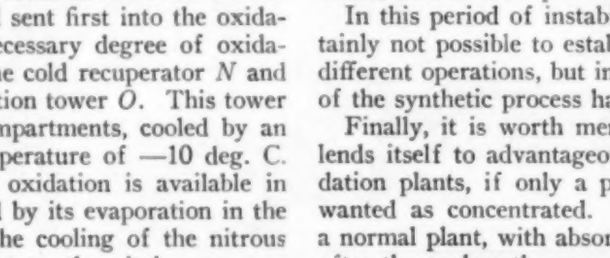
After the final absorption, the residual gases are preheated in the exchanger *E* and then sent into the turbine *R* coupled to the turbo-blower, to recover a part of the energy required for the compression.

The steam produced by the boiler, if it has no other utilization, is used to run the steam turbine *S;* in such a way the consumption of electric energy is reduced to only 130 kw.-hr. per ton of nitric acid at 100 per cent.

The mixture of dilute nitric acid and nitrogen peroxide, from the condensation column, is sent by means of the pump *T* into the autoclave *U* where the temperature is raised to 70 deg. C., and at the same time oxygen is introduced by means of the compressor *V*, up to a pressure of 50 atm. Under these conditions, after four hours, acid at a 98 per cent concentration is produced.

In this period of instability and uncertainty, it is certainly not possible to establish exactly the cost prices of different operations, but in most localities the superiority of the synthetic process has been clearly shown.

Finally, it is worth mentioning too, that this process lends itself to advantageous application in existing oxidation plants, if only a part of the total production is wanted as concentrated. For instance, in the case of a normal plant, with absorption at atmospheric pressure, after the coolers the necessary quantity of nitrous gases can be withdrawn, compressed by means of a turbo-blower into the condensation column, discharging the residual gases in the existing absorption plant. In the case of a plant with absorption under pressure, the problem is simplified, inasmuch as it will be sufficient to insert the condensation column directly after the oxidation towers.



**Turbocompressor for nitrous gases and waste-steam turbine**

# BLASTING WITHOUT EXPLOSIVES—

# A NEW JOB FOR CARBON DIOXIDE

By FRANK H. KNEELAND

*Research Engineer*
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*Benton, Ill.*

IN INDUSTRIAL blasting, there is a demand for two broad groups of explosives. Thus quarrying demands a disruptive action, something that will shatter the rock into fragments of such size as can be readily handled. Large pieces, as a rule, are not wanted. At the other extreme lies coal mining, where reasonably large lumps and as nearly a total absence of fines or "slack" as possible is the desideratum. A slow heaving action is desired and consequently common black gunpowder has long been a favorite means for dislodging coal from the working face.

Sometimes considerations other than the effect desired become determining factors in the selection and use of an explosive. Thus the presence of "fire damp" (methane or natural gas) or that of coal dust, or both, may preclude the use of black powder with its long hot flame, even though from the physical standpoint its action might be almost ideal. Recourse must then be had to some form of "permissible" explosive or some other device for dislodging the mineral. Unfortunately, permissibles are as a rule much quicker in their action and consequently have a more pronounced shattering effect than does ordinary black gunpowder.

Again, in blasting certain materials in which color or appearance is important, a powder stain or a powder burn may prove disastrous. This is particularly true of monumental marbles, and salt or other chemicals that have become caked in bulk storage.

### A Carbon Dioxide Cartridge

In order to secure a pushing or heaving action as well as to assure safety in the presence of explosive mixtures of gas and air, a blasting device, known as "Cardox," was developed and placed on the market. Even the comparatively few years that have elapsed since its introduction have witnessed many improvements and simplifications in both equipment and practice.

The basic principle is extremely simple. The Cardox shell consists of a cylinder or bottle made of a high-grade alloyed and heat-treated steel having an unusually high tensile strength. This bottle is closed at one end by means of a rupturable disk of ordinary mild steel. The latter is held firmly in position by a cap, containing vent holes, which is screwed to, or rather into, the end of the shell body. The inner end of this cap forms a shear ring against which the disk rests.

Into the other end of the shell a "heater" is inserted. This consists of a paper tube containing chemicals capable of reaction with each other and producing intense heat quickly. In addition to the heater powder (which is a mixture of one or more oxygen-carriers, such as potassium perchlorate, and one or more reducing agents, such as powdered aluminum and charcoal) this tube contains a common electric matchhead or squib. One leg wire from the matchhead terminates at the side of the heater tube and makes electrical contact with the shell body at its terminal or throat opening; the other leg wire passes through the wooden plug that closes the upper end of the heater tube. It is here wound in a flat coil lying at the bottom of a cone-shaped depression in the end of the wooden plug. When the terminal shell cap is screwed down, this coil makes electrical contact with an insulated electrode contained within the body of the cap and forming one of its component parts. Another important part of this cap is the filling or charging valve.

After the heater and disk have been put in place and screwed up tight, the shell is placed in a suitable charging rack and liquid carbon dioxide at a temperature of from 0 to 20 deg. F., and a pressure approximating 900 lb. per sq.in. is pumped into its interior. When the desired charge has been introduced (which may be determined by weighing) the filling valve is closed and the shell is ready for use. Thenceforward until discharge it is treated exactly as if it were a charge of explosive.

### "Blowing Up" With Carbon Dioxide

Suppose that this shell is to be used for bringing down coal. It is taken into the mine, slipped into the borehole previously drilled, the lead wires are attached one to the shell body and the other to the insulated electrode already mentioned, the shell shoved to the back of the hole and tamped in place. The operative then retires to the nearest

breakthrough or other point of safety, connects the lead wires to the terminals of a blasting machine and gives the handle a twist. This fires the matchhead, and starts the heater chemicals into action. In about 1/85 of a second the heater liberates enough heat to gassify or evaporate the entire charge of carbon dioxide within the shell and the pressure jumps from 900 lb. to 15,000 or 20,000 lb. per sq.in. This is more than the soft steel disk closing the discharge end of the shell will stand. Its unsupported central portion first bulges and then shears out completely, releasing the carbon dioxide against the coal, which is heaved or pushed down by the expansive force of this gas.

The difference in the action of the commoner explosives and Cardox may be readily appreciated when it is considered that black powder has an explosion pressure of approximately from 50,000 to 56,000 lb. per sq.in.; the permissibles have a corresponding pressure ranging from 100,000 to 150,000 lb. per sq.in. Cardox has no explosion pressure but the release pressure, or that at which the disk ruptures. By the use of disks of different thicknesses this release pressure may be varied from about 7,000 to 35,000 lb. per sq.in. In blasting any specific material the most advantageous strength of charge, that is, the ratio between weight of heater, thickness of disk and weight of carbon dioxide, is determined by experiment. Thereafter the shells are loaded in a central charging station with the result that the strength of load cannot be varied to suit the whim and caprice—in short the "judgment"—of the man doing the actual blasting. This prevents "overshooting."

Although developed primarily for the production of coal, this "permissible blasting device," as it is styled by the Bureau of Mines, possesses large possibilities for dislodging other materials. This spring it was used quite successfully, on an experimental scale, for bringing down salt that had caked during bulk storage in a warehouse in the heart of Chicago. Here its greater safety, absence of noise (a discharge could hardly be heard 100 ft. away) and freedom from staining were considerations much in its favor. On the other hand its disintegrating effect was less pronounced than that of a "quick" or "high" explosive. The fact that Cardox shells are made in two different diameters ($1\frac{3}{4}$ and $2\frac{1}{2}$ in.) and five different capacities (from 20 to 100 cu.in. per shell) allows a considerable range of choice to suit varying conditions.

# Carbon Dioxide's Role in Combating Heat

WITH the price of solid carbon dioxide at the end of a decline from around 5 cents a pound in 1926 to under 2 cents a pound this year, the history of its applications and of its technical methods of production has grown in an inverse ratio. Despite the onrush of mechanical refrigeration and its concomitant chemicals (such as diclordiflormethane), perhaps because of it, the cooling methods for utilization of solid $CO_2$ are just beginning to exploit the possible market. Meanwhile the sources and processes for obtaining the material in a pure state are competitively being reduced to only the most economical.

In a paper before the American Society of Refrigerating Engineers, at Cambridge in June, J. G. Bergdoll and A. W. Ruff mentioned a new system for applying solid carbon dioxide to a mechanical circuit for indirect cooling. They went on to estimate that the potential demand for the material in the next year would be about as follows:

| *Service* | *Tons a Year* |
|---|---|
| Refrigeration of frozen foodstuffs | 1,300,000 |
| Refrigeration of perishables in carloads | 1,220,000 |
| Refrigeration of express and truck shipments of unfrozen foods | 140,000 |
| Carbonation of beverages | 44,500 |
| Total potential market, about | 2,700,000 |

They continue: "This would indicate an actual market of at least 1,835,000 tons per year, and with the present trend towards favorable manufacturing and distributing systems * * * it is reasonable to expect that this market will be equaled or bettered within four or five years."

Meanwhile liquid $CO_2$ is also forging ahead. In various types of establishment throughout the country, a fire-safeguarding method based on the automatic application of carbon dioxide has found increasing use. This June a practical demonstration was given in New York by the engineering firm Walter Kidde & Co., which developed it under the name of Lux fire extinguishing system.

The demonstration showed the installation in the document storage room of a leading bank, which required absolute protection from both fire and water. The system consists of 24 cylinders, containing 1,800 lb. of liquid $CO_2$, connected by pipes and direction valves to an overhead "sprinkler" network in the protected chambers. Attached to the sprinkler lines at certain intervals are actuators and copper discharge horns, in which a diffusing nozzle prevents possible turbulence of the gas.

The actuators are set off not by some absolute temperature but by rapidity of temperature rise, so that they may remain inactive during a hot summer and yet be released by sudden heating in cold weather. When a fire breaks out, the temperature rises, the nearest actuator is affected, and the valves throughout the system are released. The carbon dioxide rushes out of the discharge horns in a gaseous state, prevented from solidifying by careful adjustment of the pressure and rate of flow. In the demonstration, lamps and candles placed about the room were soon dimmed and then extinguished in the downpour of smothering gas.

That the system is adapted to chemical plants is evident from its users, among which are not only company vaults, cargo ships, yachts, but also automobile, paint, lacquer and petroleum plants.

# GEORGIA PREPARES FOR A NATIVE WHITE PAPER INDUSTRY

A native slash pine of ten years' growth

IF the South has waited rather long for the predicted advent of its self-sustaining pulp industry, the latter has just received its greatest impetus from the enterprise of that center of the pine country, Georgia. Under the directorship of Dr. Charles H. Herty, a Georgia experimental pulp and paper laboratory is now in operation which has enlisted the generosity of many private and engineering groups to the purpose of evolving the best operating procedure. A Georgian by birth and by choice, Dr. Herty returned to his state after a distinguished career as professor of chemistry, editor of *Industrial and Engineering Chemistry*, and leader of numerous chemical organizations, to subject Southern pine resources to the same rational technology for pulp-making that he had established in his early days for naval stores.

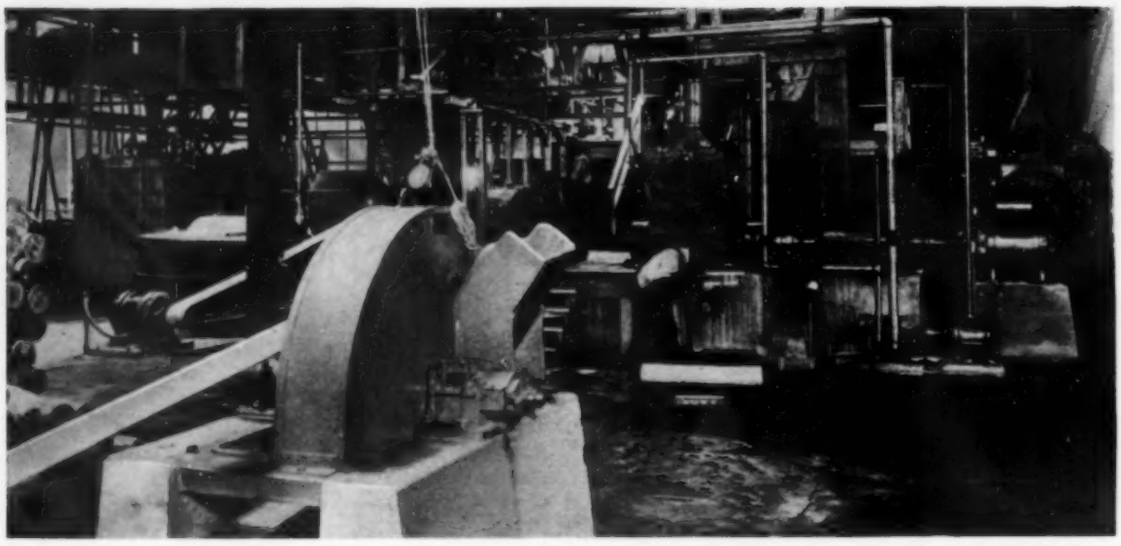
### Experimental Paper Plant

An original and highly productive technical survey has inaugurated Dr. Herty's present program, but it is the completion of his plant research facilities that will bring his discoveries to practical fruition. To this end the Georgia legislature last fall endorsed a five-year program, under a newly-created research division of the Department of Forestry and Geological developments, with Dr. Herty in charge, and appropriated $20,000 for each of the two following years. A conditional $50,000 promised by the Chemical Foundation, Inc., thereby became available for purchase of equipment. Savannah was selected by the State Commission for the location of the laboratory because of its tender of an adequate building, rent-free, together with power, water, fuel, and wood for a five-year period. For a very complete line of special equipment and reagents, the laboratory found itself able to count on the generous assistance of many equipment and chemical manufacturers. An additional $7,000 donated by the Chemical Foundation, Inc., permitted the Institute to install a complete testing laboratory.

The plant made available by the city is a rectangular 100x200-ft. storage building, accessible to both water and railroad transportation. Its equipment, seen in the illustrations, is arranged in a circuit, starting and ending at the front entrance of the building. Thus the logs are unloaded for storage here, then proceed through the grinder, chippers, digesters, beaters, and stock chest in the rear, and return to the front as paper by way of the Fourdinier machine. The testing laboratory occupies a large corner at the delivery end of the paper machine. The gentle slope of the entire concrete floor toward the rear constantly drains it into the Savannah River that passes close by.

The very critical problem of obtaining sufficient cool water for the sulphite reaction, was met by utilization of artesian wells which originate in the inland hills. This water was not only found to be cool enough to hold the $SO_2$ for reaction and to cool the reaction through lead coils, but was also of an unusually constant temperature.

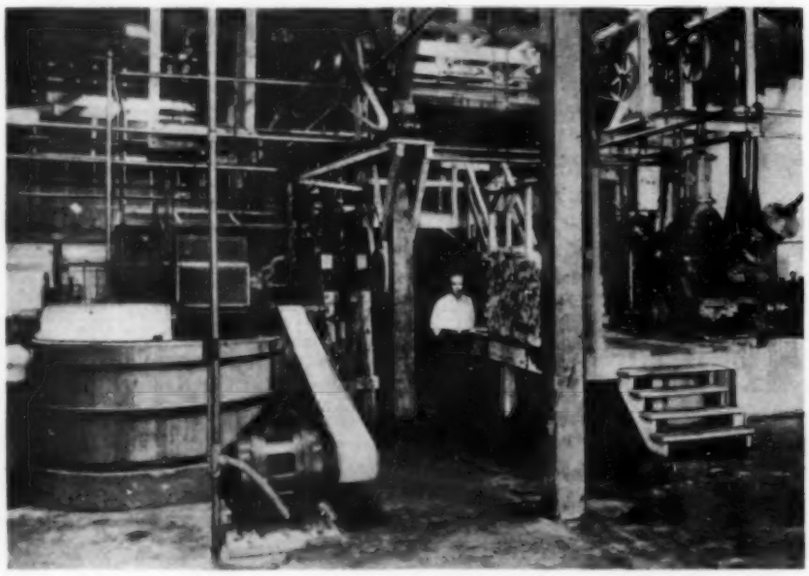
As director of the division, Dr. Herty has surrounded himself with a versatile, technical staff. The supervisor is G. C. McNaughton, who is assisted by Bruce Suttle, G. W. Lindsay, J. B. Osborne, Jr., and F. W. Hendrix.



View at front of laboratory; chipper in foreground, followed by grinder, motor and pumps

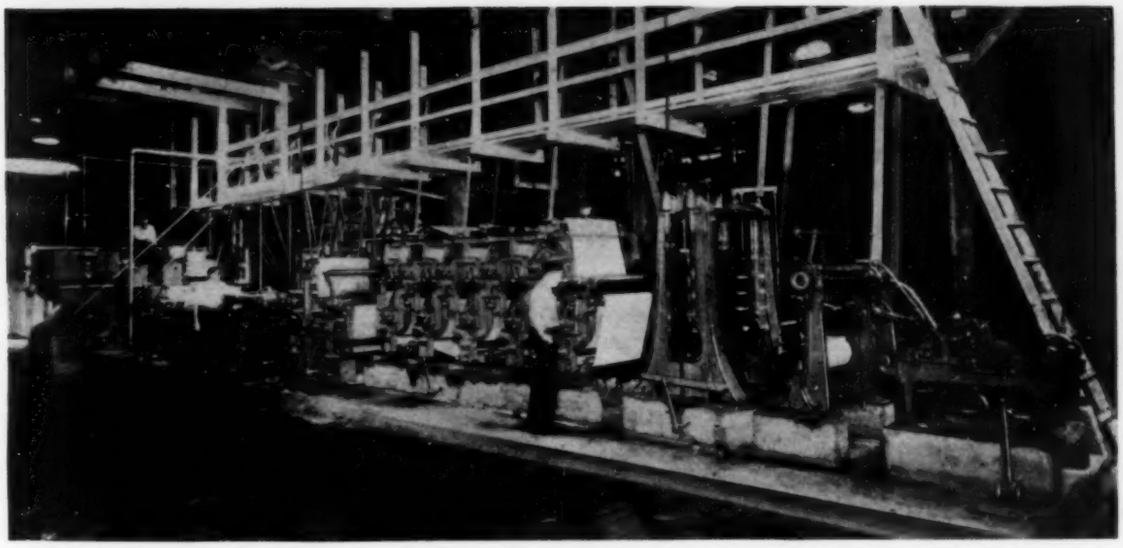
While these men work on the operating and machine problems of the plant, W. F. Allen and Spencer Noble conduct the work in the chemical laboratory.

Even before this actual plant entered its formative stage, Dr. Herty's investigation into the possibilities of Southern pines was already yielding remarkable results. Because of the resin encountered, pine has been adapted in the past only to Kraft paper manufacture. Of the species found in profusion in the South, it was first noted that the fastest-growing, the slash pine (*Pinus heterophylla*) did not acquire resinous heartwood until its 25th year. Before that it produced resin only at a wound and while the tree was alive; and after five weeks' aging the cut tree was practically resin-free except at the cut. This suggested a forestation program in which the necessary thinning process would produce white pulp to the 25th year, and the remaining trees would yield consecutively naval stores and lumber. Furthermore, it was calculated that a plant could produce 100 tons of pulp daily for an indefinite period working within only a five-mile radius, on an average haul of three miles.

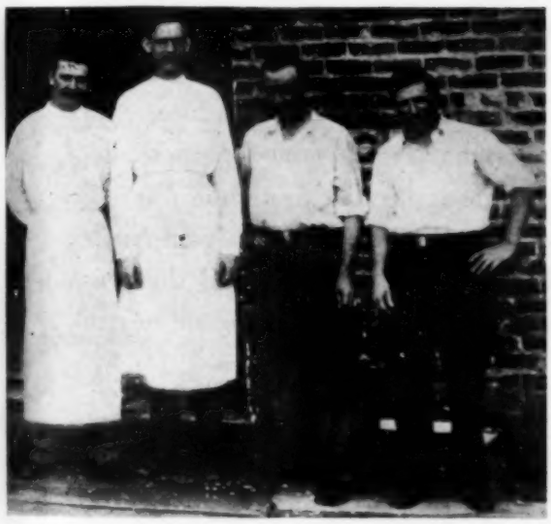


Beater in left foreground, grinder to the right

At present, slash pine covers only 10 million acres of ground in the South against 100 million of loblolly (*P. taeda*) and longleaf or Georgia pine (*P. palustris*), the noted lumber and turpentine source. It has been



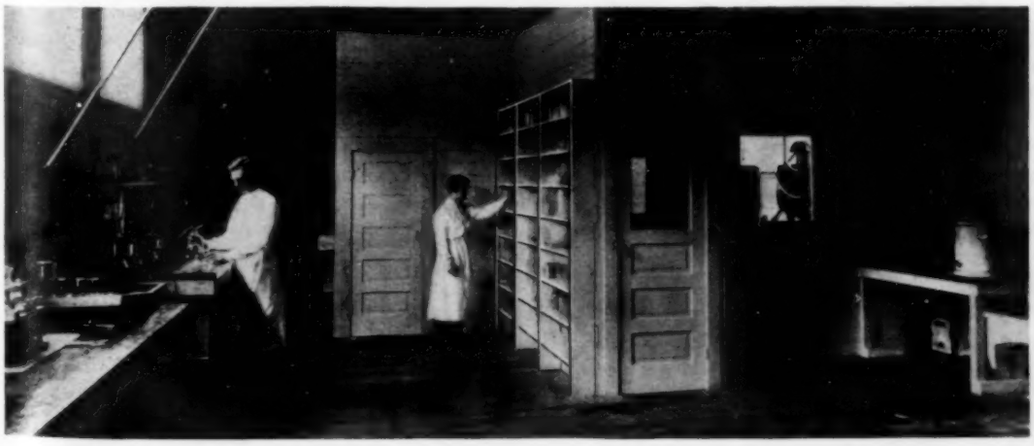
**Complete paper machine, with screens, Fourdrinier, drying rolls, calendars, cutter and trimmer**



**The laboratory staff: right to left, George Lindsay, Bruce Suttle, W. F. Allen, Spencer Noble, G. C. McNaughton, Charles H. Herty, J. B. Osborne, Jr., F. W. Hendricks, Robert Vedair**

one of the laboratory's first achievements to demonstrate that these, too, are useful for white pulp up to the 25th year and that selective cutting in a mixed growth, with its troublesome identification, is therefore obviated. It now remains for the experimental plant to determine the usefulness of two other common Southern species, the scrub (*P. virginiana*) and short-leaf pine (*P. echinata*). All varieties offer an astonishingly low raw material cost per ton of pulp produced, and fiber inspections indicate properties at least equaling those of spruce.

The other problems of this highly promising experimental project are mainly concerned with the adaptation of standard bleaching and paper-making practice to these newly-disclosed sources. To judge by the attendance of noted state officials and industrialists at the June meeting of the Georgia Forestry Association, where some of these results were presented, the laboratory's pioneering work will not lack enthusiastic backing when it is ready to be translated into commercial practice. Meanwhile the data obtained by the laboratory are available to all interested and will be released from time to time through the press and the state's official bulletin.



**Testing laboratory with constant temperature and humidity, and dark rooms**

# ALKYD RESINS DEVELOPED INTO NEW FORMS

By J. G. E. WRIGHT
*Research Laboratory*
*General Electric Company*
*Schenectady, N. Y.*

**For well over ten years the "alkyd"—or Glyptal —resins have been one of the features of General Electric Company's wide research program on plastics. In this paper, presented before the American Institute of Chemical Engineers, an official summary of some of these developments is for the first time offered. Since Glyptal arose from the company's specific needs, it was first used there as a coating; meanwhile it has gone out to wider fields of usefulness.**

ALKYD resins, which are made by esterifying polyhydric alcohols with polybasic acids, either with or without the incorporation of other reacting ingredients such as oils or oil acids, have now been before the public for some years in the form of various primers, paints, adhesives and finishes under the trade name of "Glyptal." The cast form has also appeared in Autopoint pencils and various objects d'art. With the former we have no concern at present, but we will touch upon the characteristics of the latter or cast form, for it is out of this that the newer plastic forms have developed.

For many years a great deal of time was wasted because the various experimenters could not dispel from their minds the vision of the phenol-formaldehyde type of resin and its capabilities; and it was not until the realization came to them that they were working with a substance related in its chemical and physical reactions to linseed and the other drying oils that progress began to be made.

### Mechanics of Solidification

Linseed or tung oil when heated gelatinizes; alkyd resins likewise gelatinize when heated, but we have become accustomed to call the latter process "curing." In both cases gelatinization or "curing" will not take place unless ample provision is made for the escape of volatile products. For this reason alkyd resins cannot be cured in a closed mold. In this respect they are entirely different from Bakelite and the other phenol-formaldehyde type resins. Further, if the gelatinized form of either linseed oil or alkyd resins is heated under pressure in a confined space, degelling takes place. It has, therefore, been imperative in making cast alkyd resins to heat the ungelatinized or A-stage material in shallow pans, cardboard, or some other porous box over long periods of time,—in some cases up to three months.

Paper presented before the American Institute of Chemical Engineers, Schenectady, N. Y., June 15, 1932.

The ordinary form of alkyd resin, glycerol triphthalate, gelatinizes or passes over to the B-state at about a 76 per cent esterification. Consequently, varnishes made from such a resin have high acid values. It was early observed that anything that would defer the gelatinization enabled us to obtain a higher degree of esterification in the A-resin. Of these agents the most effective was the glycol series, although marked results could be obtained from the oils, the oil acids, or the conventional plasticizers such as dibutyl phthalate, triacetin, tricresyl phosphate, etc. Ethylene glycol, therefore, came to be an invariable component of our alkyd resins for varnish work.

### Selecting Plasticizing Components

The next step in the plasticization of alkyd resins arose out of the need of developing a stock suitable for tooth brush handles, and as a general substitute for pyroxylin plastic. Much work had already been done in replacing part of the phthalic anhydride by other organic acids, among which succinic acid imparted extraordinary flexibility to such a resin. Succinic acid and ethylene glycol were, therefore, added to the new mix whereupon the discovery was made that in glycol succinate and similar bodies we had ideal plasticizers for alkyd resins.

A thorough research was then started with a view

to determining just what sort of resins would be obtained by combining one molecule of glycol succinate, then two, three, four, five, six and up to ten. The results were rather amazing. A 1:10 resin, that is to say, 1 molecule of glyceryl phthalate to ten of glycol succinate was extremely flexible, indeed quite flabby. The 1:1 was quite rigid and somewhat resembled Celluloid, in fact it was more resistant to shock than the standard alkyd resin, and we have already shown that such a resin, when cured in a plaster of paris mold makes excellent material for dentures. All samples cured much more rapidly than ordinary alkyd resin—in, perhaps, one quarter of the time, and were freer from air bubbles.

Between the 1:1 and 1:10 were all degrees of flexibility and another important observation was made, namely, that these new resins were characterized by having high internal viscosities so that when subjected to deformation, although the recovery was eventually complete and perfect, the time taken might vary from a few seconds to as many hours. Here then was a substance that might be very useful for all sorts of vibration absorption devices from magnetic pickups to automobile-engine suspension blocks.

We realized, of course, (and an investigation confirmed it) that the glycol succinate was not present as an additive plasticizer but that a molecular complex had been formed in which some of the hydroxyl groups of the glycerol had combined with the carboxyl groups of the succinic and likewise that one, at least, of the glycol hydroxyl groups had combined with one of the carboxyl groups of the phthalic anhydride.

Other glycols have now been tried and we find special virtues, for example, in triethylene glycol for some purposes. The other acids of the succinic group have also been tried, such as adipic and sebacic. For most purposes, we prefer adipic. A 1.3 adipic resin is equivalent to a 1:5 succinic or thereabout. It is therefore cheaper and usually obtainable in a purer state.

This cast form of alkyd resin is now available and is being made for toothbrush handles. By new methods and processes, we reduce the time of cure from weeks to hours. We are of opinion that this technique will lead us at no distant date to the alkyd resin transparent films.

### Adaptation to Molding Technique

Up to the present, we have spoken exclusively of the cast resin. We had always been ambitious either to cure alkyd resin in the mold and handle it like Bakelite or to apply the technique commonly used in the manufacture of Celluloid.

When we discovered that we could not cure alkyd resins in any mold other than a porous one—like plaster of paris—the thought occurred to us: why not cure first all and form afterwards by the application of heat and pressure? This was tried. The resin was cooked in the kettle until it passed over to the B-stage, at which point it rises up in the vessel like so much root beer. Heating was continued until the mass had set and would no longer sink down in the kettle when the heat was removed.

The vesiculated mass was then removed, put into an oven, and kept there until thoroughly cured. Then the fine material was inserted in a mold and subjected to heat and pressure. The result was a beautiful, transparent and apparently homogeneous piece. Unfortunately, it decrepitated upon standing; or, when put into water or into an oven at a very mild temperature, it fell apart like so much sand. Manifestly, all we had done was to force together minute lumps of jelly which were interlocked and kept together by purely mechanical forces.

A second attempt was made by selecting a piece of cured alkyd resin sheet—about an eighth inch thick—and by heat and pressure forcing it into the form of a shallow ash tray, the side of which was bent up at an angle of about 60 deg. Again, we secured an apparently homogeneous article, but when we put the ash tray into water or subjected it to say, 100 deg. C., the bent-up portion came off in a complete ring. What had happened—and this is important—was that the gel structure had broken down at the point where the resin was compelled to follow the contour of the mold. Inasmuch as this breakdown of gel structure does not occur with Celluloid, which is apparently the same sort of substance considered physically, it looked as though we were confronted with a problem in plasticization—whatever that may mean.

### The Nature of Plasticizers

Focussing our attention then on Celluloid, we came to the conclusion that nitro-cellulose is not plasticized with camphor as is commonly supposed, but by camphor plus alcohol. When we say "camphor" and "alcohol," we mean, of course, any substance that may be substituted for these, such as tricresyl phosphate and acetone. The important point is that a swelling agent is an important part of the procedure, if not a *sine qua non*. I quote from memory, but I think I am right when I say that even after ten years, 2 per cent of solvent can be distilled out of a movie film. The presence of solvent then is part of the plasticization process.

The experiment was tried of taking cured, or nearly cured, alkyd resin, soaking it in acetone or methyl Cellosolve, and puddling it with camphor. The mass was then thrown on the rubber-compounding rolls and was found to "workup" exactly like rubber or pyroxylin plastics. The material could easily be molded, took a sharp impression, did not decrepitate or disintegrate with heat or water and was occasionally nearly transparent. The material was, of course, now a thermoplastic, but it could be cured by careful heating outside the mold especially if zinc oxide or some other basic substance were added. Various swelling agents and plasticizers were tried and much work remains to be done.

This procedure has been temporarily at a standstill on account of more promising leads, but it holds out some possibilities, especially as we are inclined to think that it may be generally applicable. The thought we have in mind is—may not any gel, by the choice of a suitable swelling agent and a suitable plasticizer give a material capable of being handled by the Celluloid technique? Certain experiments we have made induce a spirit of optimism.

### How to Plasticize Alkyd Resin?

We have said above that the problem is essentially one of finding a suitable swelling agent combined with a suitable plasticizing agent. Because alcohol and camphor

may be the best possible materials for nitrocellulose, it does not follow that they are ideally fitted for alkyd resins. Recollecting our work with the cast form, we asked ourselves the question: May not glycol succinate or glycol adipate be the ideal plasticizer for alkyd resins? and inasmuch as they are already "internal" plasticizers, need they have their structure opened out by a swelling agent, as is the case when we add an "external" plasticizer such as camphor? In other words, why not throw the cured cast resin on the rolls as it is and see what will happen?

This was done and to our amazement the material "worked" up as readily as rubber.

The resulting compound could be molded, extruded, planed on a standard sheeting machine, and with a slight modification callendered. The milling operation had made it thermoplastic, but again by careful heating the cured state could be induced. Since the curing of the material was important, we tried to impart rigidity by the incorporation of fillers and were moderately successful, but eventually we found that the cured alkyd resin itself was the best filler and this is now our preferred technique.

Approximately 25 per cent of the resin in the B-state is taken as the binder, the remaining 75 per cent is heated in a dough mixer until thoroughly cured. In this operation it is reduced to a fine meal. The two are milled together with the addition of a little zinc oxide to assist curing and of such filler as seems desirable,—lamp black, cork, asbestos, whiting, as the case may be. Fillers apparently behave towards these plastic alkyd resins as they do towards rubber. Thus the lamp and carbon blacks reduce the tendency to deformation and increase elasticity, that is to say, they lower the internal viscosity and shorten the time of recovery.

### Properties and Applications

Already we are on the brink of many important applications, but before making out a list of these, we shall consider just what physical, chemical and electrical properties we have at our disposal:

I. The material can readily be extruded in any size or shape in tube or ribbon form or around wire.

II. It can be callendered in the manner of rubber or frictioned into cloth; or it can be shaved down to a few mils thickness by the standard Celluloid sheeting machine.

III. It can be molded like an ordinary thermoplastic, but is capable of being cured outside the mold or inside a porous mold.

IV. It is readily compounded with the usual fillers.

V. It can be made in any degree of flexibility from extreme flabbiness to celluloid-like rigidity.

VI. The internal viscosity is greater than that of rubber, but this varies a great deal according to the resin composition and the choice of filler.

VII. Mechanical strength varies again according to the resin composition and choice of fillers. An extruded ribbon 13 mils thick and 1-in. wide had a breaking strength of 3,000 lb. The more rigid variations are close to the strength of pyroxylin plastic.

VIII. It is extraordinarily oil- and gasoline-resistant.

IX. It is very resistant to corona discharge, and has excellent dielectric strength.

X. It is very impervious to hydrogen and other gases.

XI. It maintains its flexibility and elasticity at temperatures as low as 0 deg. F.

The following is a partial list of applications of these flexible resins which we believe show great promise.

I. Lithographic rolls and blankets.

II. Oil-proof gaskets, floor coverings, especially for packing houses, and special sheeting for the ballonets of rigid airships.

III. Wire covering especially where oil resistance, dielectric strength and corona resistance are desiderata. Also electrical spaghetti and gasoline and oil hose.

IV. Vibration absorption material for motor mountings or in the form of curtains for sound-proofing walls.

V. The possible use of the cast material for transparent films, besides for certain applications as in toothbrushes.

An excellent beginning has been made in the manufacture of lithographic rolls. Rubber rolls in lithographic printing last only about six weeks. After four weeks' exposure to the printer's ink they swell and will only run another two weeks or so after regrinding. Flexible alkyd resin rolls last indefinitely. We are speaking now of the off-set rolls. No satisfactory material except alkyd resin has yet been found for impression rolls. Both rubber and leather "beat down" and paper covered rolls require constant repairing. In the preparation of these rolls, the material may be either extruded in the form of a tube, which is slipped over the mandrel, or simply wound around like a blanket.

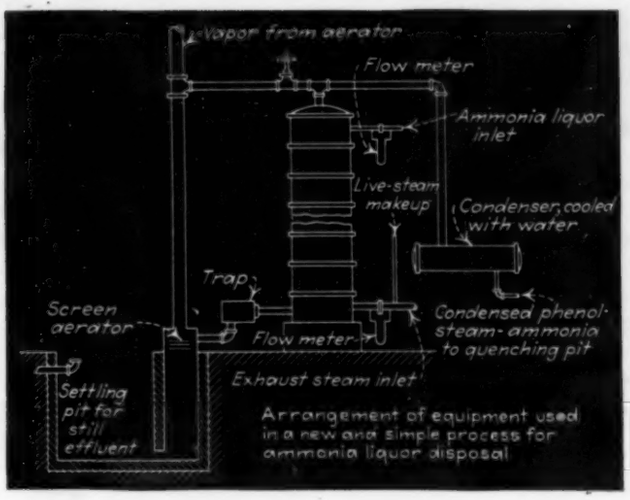
In the case of oil-proof gaskets and floor coverings, it may often be desirable to add cork or asbestos. The best results, however, as regards oil resistance are probably obtained with an all-resin material or perhaps with the addition of a little fine filler. Just how resistant to oil and gasoline these gaskets are, may be illustrated by comparison of the best rubber compound we could find, which took up 72 per cent of mineral oil at 85 deg. C. in two days, with the alkyd resin, which in the same time and at the same temperature absorbed less than 3 per cent.

A possible new method of coil insulation is to either extrude or wrap around the conducting wire a thin layer of alkyd resin which will be thoroughly cured. This ensures the irreducible space factor the electrical engineer so insists upon. Over this is extruded another layer which is kept in the uncured state. The coil is then wound and while yet in the flat form is subjected to heat and pressure in a mold. In this way, the soft outer resin fills out all the intersticies and a solid block of insulation results, having the conducting wires therein equally spaced. The final operations would consist in warming the coil, drawing to shape and oven curing.

In conclusion we would like to emplasize the unusual adaptability of alkyd resins. All other plastics require their own special technique—rubber, celluloids, Bakelite, the casting resin and the drying oils. Alkyd resin can be handled by the technique peculiar to all other plastics and in each case contributes something worthwhile and new.

## NEW ALL-RESIN VARNISH

At the annual convention of the western zone of the National Paint, Oil, and Varnish Association, San Francisco, W. H. Breuer announced a new "Beckosol" resin made by Beck, Koller & Co., Detroit, which unlike its precursors, is not a simple solution of resin in drying oil, but a solution heated to the reaction point where it forms a chemical combination. It stills remains reactive, but is a 100 per cent fluid resin, with the former vehicle as an integral component.



Arrangement of equipment used in a new and simple process for ammonia liquor disposal

# DISPOSING OF AMMONIA LIQUOR AS A WASTE PRODUCT

By D. V. MOSES and B. H. MACKEY

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*E. I. du Pont de Nemours & Co., Inc.*
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DISPOSAL of coke-oven wastes having a comparatively high phenol content is a problem which has attracted considerable attention because of its influence on public water supplies. Phenol contamination, even at the extremely low concentration of one part per billion, imparts a disagreeable taste to water chlorinated for domestic use. Authorities charged with the control of stream pollution are at all times alert to prevent discharge of untreated phenolic wastes into public water supplies.

During the past two years, the byproduct ammonia liquor from the coke ovens at the Belle, W. Va., works of the du Pont company has been disposed of in the coke quenching process either by its addition to the quenching water or by its use in undiluted form as a preliminary quench preceding the main quench. Both systems were found to lead to difficulties in increased corrosion of the quenching car and absorbed compounds in the coke that aggravated corrosive conditions in gas making. Consideration was given to other methods of ammonia liquor treatment in common use, but it was found that a considerable investment in new equipment would be required and added complication and expense of operations would result. Since recovery of byproduct ammonia is not now economical as compared with synthetic production and since the phenol recovery at market value will not pay operating expenses, it was decided to investigate methods of treatment that would permit wasting these materials and would, as far as possible, fit available equipment. A simple distillation method based on ordinary analytical methods for phenol was evolved and is described here.

An analysis of the ammonia liquor before treatment showed approximately 5 grams per liter of phenolic constituents, 5 grams of free ammonia, 11 grams total ammonia, and 11 grams of chloride. Cyanogen, sulphides, and sulphates totaled approximately one-half gram per liter.

A number of distillations of the liquor were made in ordinary distilling flasks and an efficiency of phenol removal of 98 per cent noted. The concentration of phenol in the vapor was found by analysis of the various fractions to be approximately twice that of the contact liquid. A check distillation of a phenol-water mixture having a concentration of 5.5 grams per liter gave results almost identical with those obtained with ammonia liquor. The effect of added ammonia upon the volatility of phenol was studied and it was found that the addition of large quantities of ammonia during distillation tended to retard the removal of phenol while small quantities had little or no effect. The addition of carbon dioxide during distillation had no noticeable influence on phenol removal.

In order to determine the possibility of volatilization of ammonium chloride (to which substance most of the corrosive tendencies previously mentioned are attributed), a 5 per cent solution of ammonium chloride in water was distilled to one-half its volume and the distillate tested qualitatively. No chloride was found, and it was therefore concluded that the non-corrosive, taste-forming materials (phenols, cresols, etc.) could be separated from the corrosive ammonium chloride to an extent which would permit the latter to be wasted to the river. Steam distillation experiments were conducted on a full scale with available plant equipment as shown in the diagram at the top of this page.

A 27-plate regeneration column 5 ft. 2½ in. inside diameter, each plate having 62 bells of 5 in. outside diameter was equipped with standard orifice type flow-meters on the liquor inlet to the top tray and the exhaust steam in-

let below the bottom tray. (See diagram of equipment arrangement.) During experimental operation, the vapors were wasted to the atmosphere through a vent pipe.

The theoretical steam requirement was calculated from the vapor concentration noted in the laboratory, the steam required to heat the liquor from atmospheric temperature to boiling, and that required to compensate for radiation losses as measured by operation of the column without liquor flow. Dilution from condensate was included at the value indicated by the vapor concentration. The total requirement was calculated to be approximately 80 per cent of the weight of entering liquor.

Operation of the column was started with this steam requirement and a flow of 250 gal. per hour of tar-free liquor. The phenol content of the effluent was found to vary from 15 to 38 parts per million. The steam flow was reduced without loss of efficiency to 59 per cent of the liquor weight plus a constant quantity of 600 lb. per hour to care for radiation losses. Below this value, the concentration of phenol in the effluent was found to increase sharply. A further reduction could have been obtained by the use of heat exchange between the entering liquor and effluent, but with an excess of exhaust steam available, this was not considered of importance. The relation between entering liquor and required steam flow is shown in the accompanying chart.

During 43 days operation at a liquor flow of 250 gal. per hour and a steam flow of 1900 lb. per hour (using low-pressure exhaust steam), the average phenol content of the effluent was 31 parts per million with a single maximum of 113 parts per million. The concentration of phenol in the entering liquor was 5 grams per liter. When corrected for the 30 per cent increase in volume of liquor treated due to condensation, the average phenol removal was 99.2 per cent. At the end of the above period, the column, which is of cast-iron construction throughout, was opened and found undamaged by corrosion.

In order to ascertain the amount of phenol remaining in the column at various points, a series of samples were taken from various trays during operation and the phenol determined. The results which are shown graphically in the adjacent diagram, indicate that the number of trays is in excess of that required. The phenol removal is nearly identical with that of free ammonia and the capacity is indicated as similar to that of a still removing free ammonia.

### Disposing of Vapor and Still Effluent

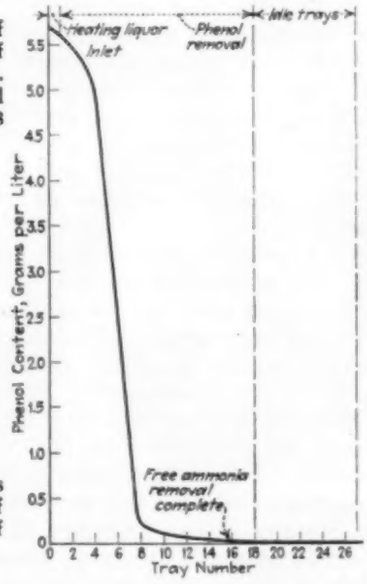
During experimental operation the still vapors were vented to the atmosphere, and it might be claimed that because of localized condensation, the immediate surroundings would become saturated and phenol returned to the river. Consideration was given to the possibility of wasting the vapors with stack gases and to condensation and return to the quenching pit. Because of the length of line between the column location and the stack and the difficulty of revaporizing any condensate formed in the line, it was decided to condense the vapors in a condenser having aluminum tubes and a cast iron shell and to use the condensate for coke quenching. Qualitative tests for chlorides made on the condensed vapors have confirmed laboratory experiments indicating the absence of carryover. Since the coke is not intended for domestic consumption, difficulty from unpleasant odors due to the absorbed phenol from the quenching water is not expected.

The effluent from the still is ordinarily a clear yellow to light red color but darkens rapidly upon exposure to air. A small amount of solid material is precipitated and can be separated by settling. The simple aerator consisting of four screens over which the effluent passes countercurrent to the flow of air and the settling chamber which will give one hour retention have been planned to reduce solid material carried into the river.

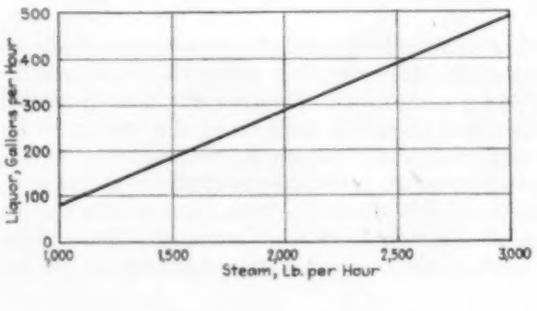
Plant operation has been controlled by analysis of the effluent twice per shift by a rapid method and by daily laboratory analysis of a composite sample by a more exact method. The method used in the plant is a more sensitive modification of that developed by J. A. Shaw (*Ind. and Eng. Chem.* (Anal. Ed), Vol. 1, p. 118, 1929) in which a double-sized sample is used and concentrated to the volume specified after the addition of sodium hydroxide to fix the phenols. The method used in the laboratory is described in the "Methods of the Chemists of the U. S. Steel Corporation for Sampling and Analysis of Coke and By-products." Results previously shown were obtained by use of the latter.

A series of official tests made by chemists under the supervision of the Ohio River Board of Engineers on samples of the effluent from the column indicated that it was of a quality superior to the waste from other processes with regard to taste-forming constituents and oxygen consumption. A test of the effect on fish life

**Distribution of phenol on trays of distillation column. Complete removal required only 18 trays**




**Steam requirements for distillation of various rates of liquor flow.**



conducted at the West Virginia State Trout Nursery at Petersburg showed no harmful effects on trout at less than 1 per cent concentration of effluent by volume. The process was therefore put in regular commercial operation.

It is believed that the process as outlined can be carried out in any ammonia still provided reasonable care is used in setting the necessary steam/liquor ratio by correlation with effluent analyses. The still capacity is dependent on many factors such as permissible back-pressure, design of trays, etc. and can best be determined experimentally. In general, the capacity should be the same as for ammonia removal. If a dephlegmator is included, it should be disconnected or by-passed, as the refluxing will return phenols to the still. The method of vapor disposal, whether by stack dilution or condensation, is dependent upon local conditions and the intended use of the coke.

▼ ▼ ▼

## HOW ALCOHOL AND BENZOL COMPETE AS MOTOR FUELS IN WORLD MARKETS

MOTOR FUELS must by law or governmental decree contain alcohol in a number of countries. Equally compelling economic conditions force benzol into the motor fuel use in many cases. Thus the distributor of gasoline is compelled today to take into account many considerations which lie wholly outside of petroleum economics. A recent government report (Trade Information Bulletin 805 of the Department of Commerce) gives a statistical basis for considering these problems. The accompanying two tables which relate to foreign production of alcohol and benzol for motor fuels, and the consumption of various types of motor fuel, are taken directly from that bulletin, with the exception of the estimated figures for consumption of the motor fuels in the United States, prepared by *Chem. & Met.* on the basis of the statistics of the United States Bureau of Mines.

Some years ago Hungary, Germany, and France established by governmental dicta the requirement that alcohol must be included in motor fuel, in order that the national production of alcohol in those countries would find market. This form of "relief" of agricultural difficulty was particularly successful in central Europe; and now Italy, Austria, and some of the other smaller nations either have joined in this practice or are considering such requirements. Similar need for encouraging the market for alcohol made from agricultural raw material occurred in Brazil, Cuba, and Chile; and all three of these countries have or are attempting to establish similar requirements.

### A Threat to Solvents Market

It is evident that this artificial promotion of the alcohol market may result in an over-development of that industry abroad, and secondary consequences are not at all improbable. It is important, for example, to consider what would be the consequences, if these regulations regarding the use of alcohol in motor fuel were withdrawn. The alcohol released would certainly become an important threat upon the international solvents market. Even American anti-dumping regulations might not be a sufficient barrier to prevent domestic price decline of alarming magnitude. World prices certainly would collapse promptly were any such sudden readjustment to occur although this now appears quite remote.

**World consumption of motor fuels**
(Millions of Barrels of 42 U. S. gallons per year)

| | Gasoline | Kerosene (b) | Gas and Diesel Oil | Alcohol for Motors | Benzol for Motors | Blended Fuels | Known Total |
|---|---|---|---|---|---|---|---|
| United Kingdom | 30.9 | 7.6 | 4.2 | *a* | 0.9 | 2.0 | 45.6 |
| France | 19.4 | 1.7 | 2.2 | 0.2 | 0.4 | .... | 23.9 |
| Canada | 18.0 | 1.3 | .... | .... | .... | .... | 19.3 |
| Germany | 14.7 | 1.6 | .... | 0.4 | 2.3 | .... | 19.0 |
| Australia | 6.4 | 0.7 | 0.8 | *a* | *a* | 0.1 | 8.0 |
| Argentina | 5.8 | 0.5 | 0.8 | *a* | .... | .... | 7.1 |
| Italy | 4.0 | 1.4 | *a* | *a* | .... | *a* | 5.4 |
| Japan | 3.5 | 0.8 | 1.4 | .... | *a* | 0.1 | 5.8 |
| Spain | 3.4 | *a* | 0.5 | .... | *a* | .... | 3.9 |
| Sweden | 2.8 | 0.6 | *a* | *a* | .... | 0.2 | 3.6 |
| India | 2.4 | 7.5 | *a* | .... | *a* | .... | 9.9 |
| Belgium | 2.3 | 0.7 | *a* | .... | 0.1 | *c* | 3.1 |
| Mexico | 2.1 | *a* | *a* | .... | *a* | *a* | 2.1 |
| Denmark | 2.0 | 0.8 | *a* | .... | *a* | *a* | 2.8 |
| Brazil | 1.8 | 0.8 | *a* | *a* | .... | *a* | 2.6 |
| Union of So. Africa | 1.8 | 0.4 | *a* | *a* | .... | *a* | 2.2 |
| New Zealand | 1.8 | *a* | *a* | .... | *a* | *a* | 1.8 |
| Netherland India | 1.6 | 2.3 | 1.8 | .... | .... | .... | 5.7 |
| Czechoslovakia | 1.6 | 0.1 | 0.2 | *a* | 0.1 | *a* | 2.0 |
| Switzerland | 1.3 | *a* | *a* | .... | *a* | *a* | 1.3 |
| Austria | 1.2 | 0.3 | 0.3 | .... | *a* | 0.1 | 1.9 |
| Other countries | 11.5 | 5.9 | 4.1 | 0.2 | 0.2 | 0.3 | 22.2 |
| Total | 140.3 | 35.0 | 16.3 | 0.8 | 4.0 | 2.8 | 199.2 |
| United States | 401.6 | 31.3 | Over 25 | .... | 1.8 | *d* | 459.7 |

*a* Negligible. *b* Generally includes all uses, probably mainly an illuminant. *c* Most "gasoline" contains 6% benzol. *d* Not estimated.

**Foreign production of alcohol and benzol for motor fuel**
(Thousands of barrels of 42 U. S. gallons)

| | Alcohol | Benzol |
|---|---|---|
| Germany | 425.0 | 1487.5 |
| United Kingdom | 0.6 | 914.0 |
| France | 168.0 | 370.0 |
| Belgium | ..... | 136.0 |
| Hungary | 75.0 | 17.0 |
| Czechoslovakia | 34.0 | 53.6 |
| Sweden | 48.0 | ..... |
| Philippines | 32.5 | ..... |
| Australia | 5.7 | 23.0 |
| Austria | ..... | 25.0 |
| Japan | ..... | 16.1 |
| Spain | ..... | 15.0 |
| China | 3.5 | 4.8 |
| Mexico | ..... | 2.7 |
| Finland | ..... | 1.6 |
| Total | 792.3 | 3,066.3 |

# How to Prepare a Patent Application

By ROBERT E. SADTLER

*Patent Attorney*
*Selingsgrove, Pa.*

**The attorney is always the best man to handle patent matters. But even if he is highly qualified, his client's technical help is preferably given on a basis of patent knowledge; if he is not, the client will absolutely need it.**

THE patent office advises inventors to employ a competent patent attorney to prepare their patent applications. However, in some cases where it is impossible or impractical for the inventor to obtain the services of such an attorney, he is forced by necessity to formulate and file his own application. The following suggestions are submitted to chemical inventors who prepare their own applications, so that the patent may be in proper form and satisfactory to the personnel of the patent office, to the courts, and to prospective purchasers.

### Comprehension of Problem at Hand

Fully understand the problem the invention has solved. What were the limitations of the prior devices, processes, or compositions of matter? Why is the new device, process, or composition desirable?

Have a clear grasp of all details of the particular problem and how the new device, process, or composition is to function to solve it.

Consult the following sources of information: (1) the most accessible data; (2) persons familiar with the art who should be able to explain the prior practice and differentiate between it and the new device, process, or composition; (3) further information on antecedent practice, the prior art, as evidenced by patents or publications.

### Patentable Qualities of Process or Device

Compare the device, process, or composition with any prior art available such as publications, or have a preliminary search made in the patent office for this purpose.

Compare the new device, process, or composition with what has been used before, whether patented or not, to determine whether reasonable patent protection may be obtained on the new device, process, or composition.

### Amount of Expository Material

Decide whether the device, process, or composition, in itself, is a complete new thing or whether it is an improvement of part of a device, process, or composition previously developed. In this way, it can be determined whether the entire device, process, or composition should be disclosed or whether just the essentials of the part improved need be included in the drawing and specification. In case of doubt disclose everything. Remember if we are to err either by disclosing too much or too little, the choice of evils is to disclose too much.

The United States law requires that if an invention is capable of being illustrated by a drawing it must be illustrated. A device should be fully illustrated by drawings made in accordance with patent office regulations; in the case of a process, the apparatus used for the practice of the process should be shown, but in the case of an invention relating to a composition of matter no drawing is required.

Determine the form in which the device or apparatus (for a process invention) is to be illustrated; that is, whether the device or apparatus can best be illustrated by a diagrammatic illustration or by the illustration of a finished product.

### Necessary Drawings

Make pencil sketches of the figures desired, or select from the drawings submitted by the draftsman such figures as most clearly present the invention to you.

Use the finished penciled drawing or the sketch in the dictation of the specification. Place numerals on each part of the device or apparatus and refer to each part in the description in the specification by reference to the appropriate numeral on the accompanying drawing.

### Explanatory Claims

Write claims at this stage of the preparation of the case, in order that the inventor may determine not only what elements of the disclosure are most important but also the necessity for special definitions of words and phrases which must be inserted in the body of the specification.

It is possible, however, that if the inventor has fully in mind what it is necessary to claim, the writing of the claims may be delayed until after the dictation of the case, although writing the claims first is the preferred and recommended method.

Claims are the inventor's statement of what he regards as new and invented by him. While they may have to be modified during the proceedings in the patent office, as finally allowed, they legally define the invention. The claims are added to the specification to conform to the statutes which require that the patentee "shall particu-

larly point out and distinctly claim the part, improvement, or combination which he claims as his invention." What the inventor describes but does not claim belongs to the public.

Any number of claims up to 20 may be originally included in the specification without extra charge, but there is a charge of $1 for each claim added in excess of 20. It is permissible to include different types of claims in the same case, that is, claims that are broad in scope—or claims that are narrow and specific. An inspection of any well-prepared chemical process or composition patent will reveal examples of the aforementioned types of claims.

### Outline of Specifications

Outline the order in which the various parts of the specification should appear in the finished form, in order that incoherent or illogical presentation of the case may be avoided. To make a lucid description follow the logical sequence of operation of the device. In the case of a process patent, start with the crude materials and clearly describe each consecutive operation until the finished product to be obtained is the proper form. And in the case of a composition of matter or article of manufacture patent, the same procedure should be followed; that is, starting with the crude materials, state the amount of each ingredient used in producing the final composition and give the order in which the materials are added to each other to produce the final product. In the case of process and composition of matter patents, it is well to give one or two specific examples of the process or composition which will serve to illustrate and explain the invention. It must always be remembered that the law requires that the invention shall be described with that degree of fullness and accuracy that anyone skilled in the art to which the invention pertains may follow the description of the invention given by the inventor and obtain the same results as the inventor.

### Dictation of Specifications

Open the dictated specification with a statement of the problem confronting the inventor in order to lay the groundwork for the objects to follow.

Follow next with the objects of the invention, which should be statements of the inventor's solution to the problem thus previously discussed. The objects should express in simple language the ideas and features which will later be set forth in the claims, but should not be coextensive therewith either in number or scope. The object or objects preferably should be no more than a broad functional statement of the result to be accomplished.

Include also a general statement of apparatus and arrangement used for accomplishing objects. State briefly what kind of views are represented in each figure, follow it by a few words stating what is shown or how what is shown in one figure connects with what is shown in a preceding figure.

Next in order outline the main body of the specification which, in most cases, may be divided into two parts: (a) description of the apparatus and (b) description of the operation.

A suggestion is made in the manner of writing the body of the specification which is that the specification be written in the form of short paragraphs rather than long paragraphs, irrespective of the particular rules of grammar which may apply. Each paragraph should contain in its first sentence a statement of what the paragraph relates to, somewhat after the fashion of a newspaper article in which the who, how, when, what, and why is always stated in the first sentence. The paragraph should start somewhat in this form—"The nitrogen gas in the cylinder 1 may be admitted to the chamber 2 containing ammonia by operating the valve 3." Then should follow the description of the chamber or whatever details are necessary to describe completely the operation set forth in the first sentence. In this way, persons reading the specification in the future will not be required to wade through the entire mass of the specification to learn the operation, since the first sentence in each paragraph may be sufficient to convey the thought.

This type of construction of paragraphs is of value also in later locating any portion of the specification to which attention needs to be directed; since in checking back all that it is necessary to do is to read the beginning of each paragraph until that part of the specification to be considered in detail is located. This construction is also of value from a psychological standpoint, in that it emphasizes the important elements of the invention.

### Emphasis on Purpose

While it is not essential that any form of conclusion be used in a specification, for the sake of added emphasis center again the examiner's attention upon the object of the invention. After the detailed description is finished, a short paragraph should be added to bring the mind of the reader back to the purpose of the invention as a preliminary to taking up the claims. Some paragraph such as—"It will, therefore, be seen ..... that I have disclosed a device (process or composition of matter) which will ..... (state what the invention will do)."

The usual paragraph as to the illustration and description not constituting a limitation upon the claims may be inserted at this point. The following are types of paragraphs which may be utilized:

"The foregoing detailed description has been given for clearness of understanding only and no unnecessary limitations should be understood therefrom, but it should be construed as broadly as permissible in view of the prior art."

"It is understood that the particular apparatus described above is intended to be merely illustrative and not limitative of the invention, since it is obvious that the invention may be effected by apparatus arranged in many other different ways, within the scope of the claims."

"While the invention has been described in detail with specific examples, such examples are illustrative and are not given as limitations, since other modifications within the spirit and scope of the invention will be apparent to those skilled in the art. Hence, the invention is to be understood as limited only as indicated, in the appended claims, in which the intent is to set forth all the novelty over the prior art."

Add the claims. A complete patent application comprises the following: (1) a petition for patent (for form, see "Rules of Practice in the U. S. Patent Office"), (2) the patent specification (outlined above), (3) an oath (4) a drawing (omitted in some cases, such as compositions of matter) and, (5) $25 filing fee.

# Determining FRICTION LOSSES In Piping Systems

By M. J. REED and L. H. MORRISON
*Respectively Hydraulic and Mechanical Engineer*
*New York City*

WHEN WATER or any other fluid is pumped from a source of supply to a point of delivery, work must be performed not only to raise the water from the level of the suction to the discharge level but also to overcome a loss called "friction." This loss is caused not so much by an actual scraping of the fluid along the inside walls of the piping as by eddy currents in the fluid itself.

A simple formula for the calculation of friction loss is the one usually named after Darcy:

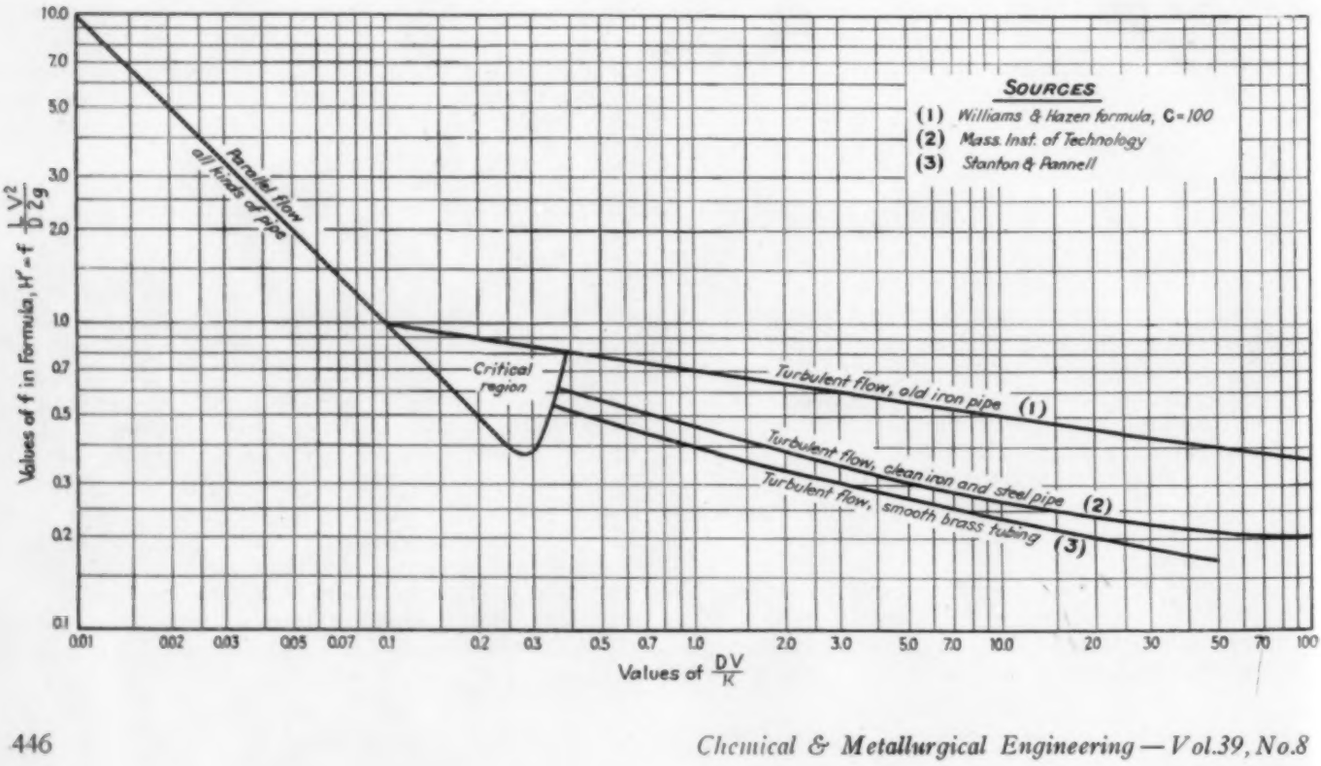
$$H' = \frac{f L V^2}{2 g D}$$

where $H'$ = friction loss in feet head of the fluid being pumped; $L$ = length of the pipe in feet; $V$ = average velocity of flow in feet per second; $D$ = internal diameter of the pipe in inches; $g$ = acceleration due to gravity—approximately 32.2 ft. per second; and $f$ = a factor varying with conditions of flow in the system.

This formula is often used to show that friction loss varies directly with the length of the pipe, directly with the square of the velocity, directly with the square of the capacity, and inversely with the first power of the internal diameter of the pipe. The first relation is quite obviously true; the second, third and fourth are only approximately correct for the reason that the factor, $f$, does not remain constant for changes in $V$ or $D$.

The fact that the factor, $f$, is not a constant but changes with any change in the factors which determine the nature of flow makes it necessary to examine these factors in more detail. These are: the velocity of flow, the internal diameter of the pipe, the viscosity of the fluid being pumped, and the specific gravity of the fluid. Professor Reynolds combined these into a dimensionless factor since called the Reynolds Number. A modified form of this, using units somewhat more convenient for practical purposes, is $VD/K$ where $V$ and $D$ are as be-

Fig. 1—Relations of kinematic viscosity and friction factor for various rates of flow and conditions and kinds of pipe



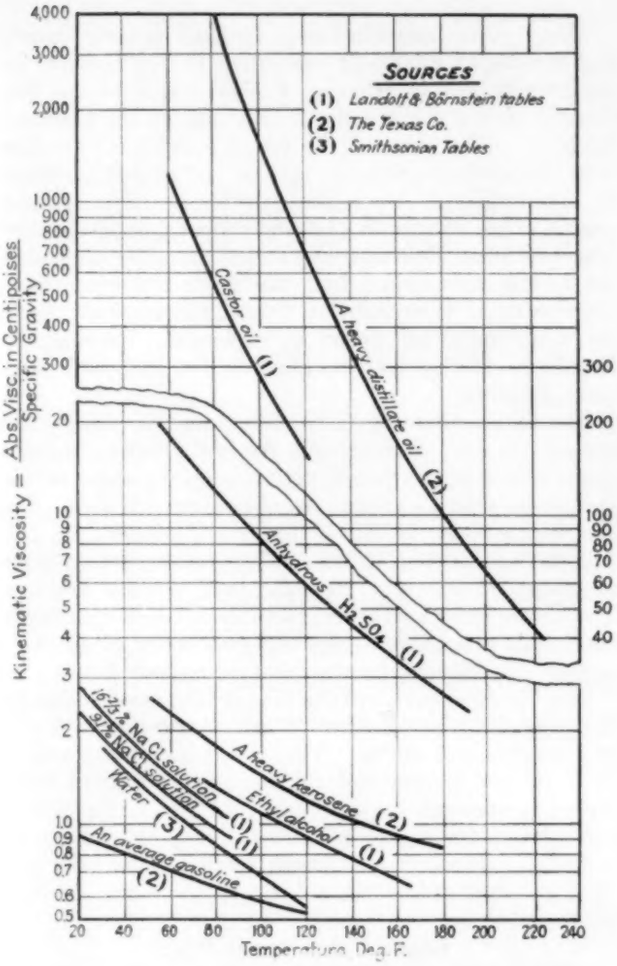



**Fig. 2—Kinematic viscosities of representative liquids at varying temperature**

fore and $K$ is the kinematic viscosity of the fluid, expressed in centipoises, or the viscosity in centipoises divided by the specific gravity. (Values obtained from this expression, if multipled by 7,740, will give the true Reynolds Number.)

Many investigators have developed the relationship which exists between the Reynolds Number and the factor, $f$. This relationship is best illustrated in curve form as in Fig. 1. It will be seen from this chart that up to values of $VD/K$ of about 0.1, there is a straight-line relationship which holds no matter what kind of pipe is used. This is the region of "parallel flow." For values above 0.35, in the region of turbulent flow, the nature of the inside surface of the piping has a determining effect on the value of $f$. It is here that the efforts of research workers have been concentrated. Between parallel and turbulent flow is a "critical" region in which the flow is unstable and either parallel or turbulent, depending on conditions.

Because the inside surface of the pipe is a factor in the friction caused by turbulent flow, there will not be a single curve for values of $f$, but a different curve for each different degree of roughness. In Fig. 1 the lowest curve gives values obtained by Stanton and Pannell for smooth tubes. The curve above this was determined to hold for clean iron or steel pipe in studies carried out at the Massachusetts Institute of Technology. The topmost curve was plotted from values given by the Williams and Hazen formula, using a constant of 100, which is the constant recommended by these investigators for iron pipe that has been in service from 13 to 19 years.

The curve of Stanton and Pannell finds practical application in the pumping of oils. Although with different units than are employed in the foregoing, it is used as the basis of the method outlined in the book of the Kinney Manufacturing Co., "Friction Pressure Loss in Oil Pipe Lines." William G. Heltzel, writing in *Oil and Gas Journal*, stated that the Stanton and Pannell values have been borne out by much actual experience with oil pipe lines from 6-in. to 12-in. diameter, carrying oil of specific gravity ranging from 30 deg. to 42 deg. A.P.I.

What curve to use for water depends on the location of the line and the nature of the impurities carried in solution or suspension. If a cast-iron line is to be laid so that cleaning will be impossible or at least very difficult to accomplish, while at the same time the water to be handled is known to badly encrust or tuberculate iron pipe, it is only prudent to use the topmost curve. It is probable, however, that the high friction values indicated by this curve are brought about more by the reduction in internal diameter through encrustation than by an increase in roughness.

If a pipe line is to be of cement-lined pipe, which is much less subject to encrustation, values from or near the M.I.T. curve should be used. Some investigators believe that for the same value of $DV/K$, $f$ should be smaller for large pipe than for small pipe having the same kind of internal surface.

### Curves Suitable for Liquids and Gases

This method of calculating friction loss has the advantage over tables in that it applies to all pure liquids and even to gases, providing the final gas pressure is not less than 90 per cent of the initial pressure. It cannot be applied to mixtures of liquids and solids, however, nor to liquids which are apt to behave as solids under the conditions applying, nor to oils if the temperature at the pipe center may be materially higher than at the contact with the pipe wall.

In Fig. 2, the kinematic viscosities, $K$, of several common liquids are shown graphically. To illustrate a calculation of friction, assume a flow of 500 gal. per minute through 1,000 ft. of 6-in. pipe. If the fluid is pure water at 70 deg. F. the kinematic viscosity from the curve is 0.98 and the modified Reynolds Number, $DV/K$, is $6 \times 5.67/0.98$ or 34.7. The value of $f$ for clean cast-iron pipe corresponding to this Reynolds Number is 0.22 and the friction in the 1,000 ft. of pipe is

$$H' = \frac{0.22 \times 1{,}000 \times (5.67)^2}{6 \times 64.4} = 18.3 \text{ ft.}$$

On the other hand, if the fluid is pure water at 175 deg. F, the modified Reynolds Number is 93 ($K$ for water at 175 deg. F is not shown on the chart, but is 0.365; for 212 deg. F. it is 0.296 and for 307 deg. F. it is 0.197). The value of $f$ to be used then becomes 0.205 and the friction loss is found to be 17.1 ft. Now suppose the liquid to be the heavy distillate oil of Fig. 2 at

140 deg. F. The flow number is $6 \times 5.67/340$, or 0.1, making the factor $f$ equal 1.0, and the total friction, 83 ft.

The last illustration happened to fall just at the end of parallel flow. Practical problems in water pumping will come within the turbulent flow region. This is evident when it is considered that a flow of 1 gal. per minute of pure water at 70 deg. F. in a pipe of 1-in. inside diameter is turbulent. Parallel flow is quite common, however, in the handling of oils.

Quite often it is necessary to calculate friction loss although the kinematic viscosity is unknown and difficult to determine. Assume that the unknown friction is for 1,000 g.p.m. in a 12-in. pipe. The only available data show a friction loss of 40 ft. in 1,000 ft. of 6-in. pipe when handling 500 g.p.m. of the same liquid at the same temperature. Working backward from the formula, the value of $f$ is found to be 0.5 (assuming clean cast-iron pipe). This indicates a flow number of 0.72. Since $DV = 34$, $K$ must be 47.3. Knowing this, it is a simple matter to calculate the friction loss in the 12-in. pipe.

### Fittings Losses Important in Short Lines

In a practical pumping system there is, in addition to friction loss in straight pipe, the friction losses at entrance, through fittings, and at discharge. These losses are not of great moment in the ordinary system where the length will probably exceed 200 diameters. For that reason much less attention is paid to these losses in manufacturers' handbooks than to straight pipe loss. However, if the length of the system is much less than 200 diameters, these losses make up a considerable part of the total friction.

Professor Daugherty, in his book on hydraulics, expresses the head lost at the entrance to the suction piping as $k_e V^2/2g$, where $k_e$ is a coefficient of loss depending on the kind of suction opening used. If this is a straight pipe projecting into the suction well, $k_e$ is 0.62 to 0.93, making 1.0 a practical figure if length ÷ diameter for the system is over 200. On the other hand, if the suction pipe enters the suction well below the surface and does not project beyond the inside wall, $k_e$ will be from 0.47 to 0.56. A projecting pipe with a conical entrance fitting, the greatest cross-sectional area of which is at least twice that of the suction pipe, gives values of $k_e$ of 0.18; and a curved, bell-mouthed entrance fitting can reduce $k_e$ to as low as 0.04. The final velocity set up in the suction piping is not, of course, a loss, since it is just as much a component of the energy of the liquid in the suction system as is the pressure.

The loss in discharging a straight pipe into air is quite obviously $1.0 \times V^2/2g$. The loss is not quite so great where the pipe discharges under water. Although the saving is not sufficiently large to take into account in the average system, if a diverging mouthpiece is fitted to an under-water discharge, the loss is considerably reduced. Professor Daugherty gives the loss in a conical diffuser with an interior cone angle of 8 deg. as $0.23(V_1 - V_2)^2/2g$. If the discharge diffuser is long enough to make $V_2 = 0.5V_1$, the loss in the diffuser is therefore $0.06\ (V_1)^2/2g$. Since $(V_2)^2/2g$ is mostly loss, the total loss, from discharge would be about $0.31(V_1)^2/2g$, where $V_1$ is the velocity in the pipe ahead of the discharge fitting. In short systems it may well pay to resort to such a fitting.

Many pump manufacturers include in their catalogs and handbooks a table of equivalent feet of straight pipe for friction loss in fittings. To cite a case of this kind, there is such a table in the "Standards of the Hydraulic Society." The values given range from 96 to 40 diameters, depending upon the size of the elbow. It would be interesting to trace these tables to their ultimate source to see if there is any experimental basis for them. The two most thorough researches into the subject, so far as the authors can find, are those conducted at the University of Wisconsin by Corp and Hartwell; and at the University of Texas by Giesecke, Reming, and Knudson. Both these studies contradict such high values quite decidedly.

The experiments of Corp and Hartwell, using short-radius, 90-deg., commercial, flanged elbows, indicated that the length of straight pipe having the same friction loss as an elbow is about six diameters for 8-in., 6-in., and 4-in. elbows, falling off to three diameters for 2-in., and to two for 1-in. elbows. These losses are increased by about 65 per cent when screwed fittings are used. The Texas experiments indicated even lower equivalents, not improbable since when using commercial elbows, a certain disparity of results must be expected.

The Texas experiments indicated that the friction loss in a 3-in. long-radius elbow is about two-thirds the loss in a short-radius elbow. This result was for a velocity of 3 ft. per second and the investigators state that a higher percentage may be expected for larger fittings, and a lower for higher velocities. They also found that a 45-deg. elbow causes about one-half the loss of a 90 deg., short-radius ell, subject to the same modifications.

### Globe Valve Losses High

Two elbows separated by a spacer, according to Corp and Hartwell, may be considered independently if the spacer is at least 20 diameters in length. When the spacer is shorter, however, the combined loss is less than the sum of two elbows plus the friction of the spacer, reaching a minimum of $7\frac{1}{2}$ diameters for two elbows joined directly without a spacer. It does not seem to make much difference what angle the discharge of the second elbow makes with the inlet of the first. This indicates that wherever two elbows are necessary in a pipe line, they should be installed as close together as possible.

Messrs. Corp and Ruble, experimenting also at the University of Wisconsin, found that the loss through gate valves fully open varied from $0.2V^2/2g$ for $1\frac{1}{2}$-in. valves down to $0.06V^2/2g$ for 12-in. valves. For valves smaller than $1\frac{1}{2}$-in., the loss is greater, being about $1.0V^2/2g$ for $\frac{1}{2}$-in. size. Globe valves should never be used in a pumping system; the loss through a globe valve wide open may be as high as $7.0 \times V^2/2g$, according to an investigation at the University of Illinois by Messrs. Talbot, Seely, Fleming and Enger.

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# Printing Ink Production

**The present day industry often includes the production of many of the ingredients of the ink even to the carbon black which is used in enormous quantities in the manufacture of newsprint ink**

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THE modern printing ink plant is not merely a place where the actual inks are formulated and compounded, but it goes back of that to the production of the very ingredients. It includes the production not only of carbon black, colors, and lakes, but even of varnish bases that are used to carry the pigments and bind them to the paper. The organization of Charles Eneu Johnson & Co. is typical, with its ink and varnish plants in Philadelphia, Chicago, and Kansas City, its color plant in Philadelphia, and its carbon-black plant in Monroe, La., supplying the ink plants.

The printing ink of today is a development of the formula of Cannefarius and was first published in 1660. In the old days, according to our contemporary *Oil-Power*, when a printer needed linseed varnish to mix with pigments for his ink, he made it himself. In fact, he made a day's outing of the affair. He took a quantity of oil pressed from flaxseeds, invited some friends, and picked out a pleasant place in the country where he could boil the oil over an open fire. The friends gathered around, and as the oil reached the boiling point, dipped pieces of bread into the thick oil at the surface. When the bread was saturated and toasted, they ate it and washed it down with ale. It was all a pleasant affair.

The story of this particular company properly begins with Jacob Johnson, originally a printer and bookseller, who in the picturesque closing years of the eighteenth century ran a print shop on Market Street in Philadelphia. In those days it was the custom for printers to mix their own ink. Johnson seems to have developed particular skill at the art, and other printers would get him to mix ink for them. This led to his selling them ink and finally abandoning his printing trade to devote himself exclusively to ink making. The demand for Johnson's ink grew, and in 1804 it was necessary to move to larger quarters at 509 Tenth Street; and it is interesting to note that while the establishment has expanded many times since then this address has remained for these 130 years as the headquarters of the company.

The original Johnson mixed lampblack and oil by hand on a stone slab, then laboriously ground it with a muller. Later, increasing business demanded more advanced methods—the introduction of machinery and power. The equipment consisted of a treadmill turning a grinding device, and the power was supplied by a sturdy cart horse.

But progress in the printing ink manufacture had to keep apace with the developments in the printing industry. Under Charles Eneu Johnson, a great-grandnephew of the founder, the firm entered into a highly progressive epoch. The stone-mixing slab and the muller gave place to modern equipment, and new inks were developed and produced in order to keep abreast of the advances in the art of printing.

### Oils Serve as Vehicles

Printing ink consists of a vehicle carrying a pigment. The vehicles, known as printing ink varnishes, are manufactured from a wide variety of vegetable and mineral oils. The most important of these are linseed, rosin, and petroleum, although tung, cottonseed, castor, and in fact nearly every variety is used to a greater or lesser extent. Each of the oils used is subject to exact specifications, and the testing of the raw materials received to see that they conform exactly to specifications is an important part of the manufacture of the varnish.

Linseed oil is received at the plant in tank cars, weighed, and pumped into storage tanks from which it is in turn pumped into open copper kettles holding about 10 bbl. of oil. It is heated in these oil-fired kettles to varying consistencies, the time of heating and the temperature being regulated. From these kettles the oil is pumped into storage tanks for the finished varnish. The consistencies of the linseed varnishes range in degree from the very fluid varnishes that differ but slightly from the raw oil to heavy viscous ones that are scarcely fluid at all.

The rosin oil for varnish is prepared by destructively distilling grade E rosin, in a steel still over an oil fire. About 80 per cent of the rosin volatilizes and distills over, cooling as it flows through water-cooled coils, and collects in a lower tank. The residue is pitch and is run

off while still hot; this was formerly known as brewer's pitch and is used for setting brush bristles. The oil is refined by a second and sometimes a third and fourth distillation.

Various varnishes are produced from the treated linseed oil or rosin oil, either alone or in combinations of the two oils in varying proportions. Metallic salts are added to some varnishes to accelerate the drying of the vehicle.

A special gilsonite varnish is produced in an open kettle over a charcoal fire. It is prepared by heating the bituminous material between 500 and 600 deg. F. for a definite time and then cooling the mass by means of coils containing cold water. Gasoline is added during the cooling process. The cooled varnish is ladled out into steel drums and sent to storage or directly to the ink plant.

### Carbon Black Production

The most important pigment, in terms of volume used, is carbon black. It is much blacker and stronger tinctorially than lampblack and gives a more glossy print. The Johnson company has its own carbon-black plant in the Monroe, La., gas fields where the pigment is produced. Gasoline is first removed from the natural gas in a gasoline extracting plant. The gas is then conducted into the given burning houses and burned from a large number of ignition tips. Heavy steel channels are placed a short distance above the burners. The carbon black is deposited from the gas flames on to the surface of these channels, from which it is continually being removed by mechanical scrapers. The black falls into hoppers feeding into troughs containing spiral conveyors which conduct the black to storage bins from which it is screened, bolted, and packed into paper bags. Bags of black are then loaded into box cars and shipped to the ink plants.

A few of the larger printing ink companies produce their own colored pigments. In this way they are able to produce colors of the type and quality they find most suitable for their use. Pigments used in colored inks consist of organic and inorganic colors. The aniline dyes, such as eosine, fluorescein, methyl violet, are prepared in a separate plant in Philadelphia. The process consists of combining the various intermediates, separating, and purifying the dye.

### Dyes Also Self-Made

Some of these dyes are used in making insoluble lakes with oxides of such metals as aluminum and chromium. The dyes, after being put into solution in water, are mixed with the metallic oxides in open-top wooden tanks equipped with agitators where the formation of the lake takes place. When thoroughly mixed the batch flows by gravity to larger wooden tanks on the floor below, where the lakes are precipitated by various means, such as by the addition of acid, alkali, or by rapid chilling or heating. They are permitted to settle to the bottom of the tank and are washed several times by decantation. The thin pulp is allowed to flow into a filter press, first by gravitation to initiate the formation of the cake, and is eventually built up by a force pump to obtain a press cake under 60 lb. pressure. The cake is not washed, but merely freed from adhering mother liquor by pressure as well as blowing with compressed air while still in the press.

At this point the moist press cake of the lake is divided into two portions. One part is further dried by evaporation and the other is used in pulp form. The former part is discharged onto wooden trays covered with paper which are placed in a vacuum dryer wherein the remaining moisture is removed at a moderate temperature. The dry colors are completed by grinding in a disintegrator. They are then stored or sent to the ink plant to be made into ink.

In the ink plant the varnishes and pigments are combined by mechanical mixing and thoroughly ground over roller mills. Both dry and wet (pulp) pigments are used in making colored inks. When the dry colors are used, the dried and ground pigments are added to the varnish and other ingredients in a Day pony mixer. After thorough mixing they are passed through a three-roller Day grinder. The grinding is stopped from time to time to allow the rollers to cool in order to prevent overheating of the pigments with accompanying loss of sheen. The ink leaving the mills by means of knives and aprons is directed into shipping containers.

In the case of heavy black inks the grinding is done on Day (tandem mills) triple three-roll mills equipped to do extra fine grinding without extra handling of material. Rotogravure ink is prepared in a separate building because of the flammable nature due to the gasoline content. Gilsonite varnish and pigments are the ingredients of this ink.

### Newsprint Inks

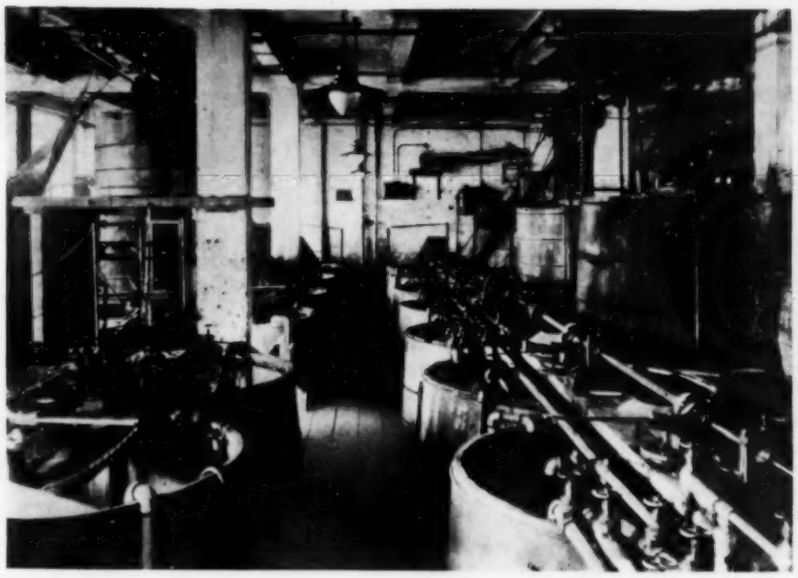
Newsprint inks are made in much larger volume than any other kind. They consist generally of about 90 per cent petroleum, 10 per cent carbon black, with small quantities of other materials. Mineral oil, for newsprint ink, is brought to the plant in tank cars from which it is pumped into large storage tanks in the basement of the building. Ingredients for this ink, petroleum, carbon black, and varnish are mixed in dough mixers. Then they are screened and pumped to a supply tank in the top of the building. From these reservoirs the ink flows by gravity to the three-roller Day mills. Each mill is connected to the supply tank by a pipe line. Mills are kept supplied by means of a float valve located a couple of inches above the trough formed by two of the rollers. This type of ink is generally shipped in 12,000-lb. tank trucks and 80,000-lb. tank cars.

### Printing Ink Production

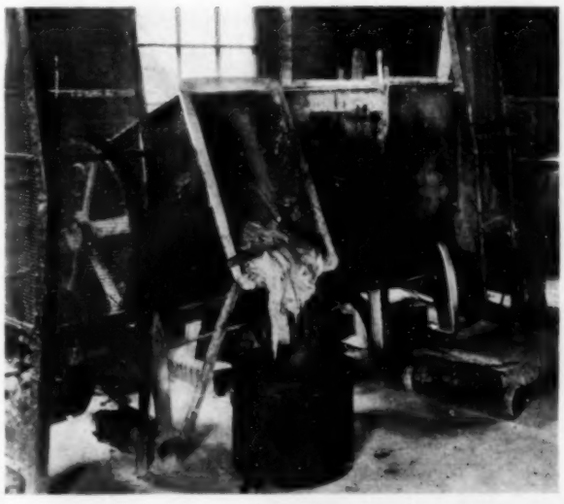
The U. S. Bureau of Census announces that, according to a preliminary tabulation of data collected in the Census of Manufacturers taken in 1932, the value of printing inks made in the United States in 1931 by establishments engaged primarily in the manufacture of this class of products amounted to $29,595,330 (at f.o.b. factory prices), a decrease of 27 per cent as compared with $40,698,391 reported for 1929, the last preceding census year. Other products amounted to $1,051,012 in 1931, a decrease of 49 per cent. The value added by manufacture in 1931 amounted to $16,675,360, a decrease of 29 per cent as compared to 1929.

This industry, as defined for census purposes, embraces establishments engaged wholly or principally in the manufacture of printing inks of various colors, gold and bronze inks, and lithograph inks.

# A JOURNEY THROUGH A PRINTING INK PLANT



Tank room where dry colors are precipitated and washed. Later they are filtered, dried, and crushed



IN the plant of Sinclair and Valentine Co., New York City, modern equipment is used instead of the stone slab and muller of the ink maker of Franklin's time. The tons of ink needed today would never be made if the pigment and varnish were still ground together by hand. Now mechanical mixing makes a homogeneous mass of the ingredients and steel-roller mills grind this paste to a smooth consistency.

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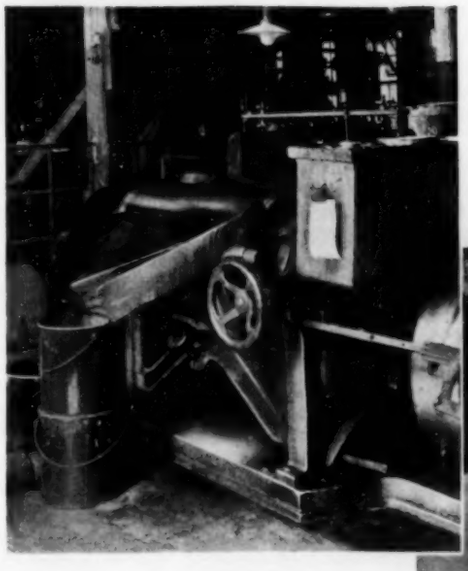
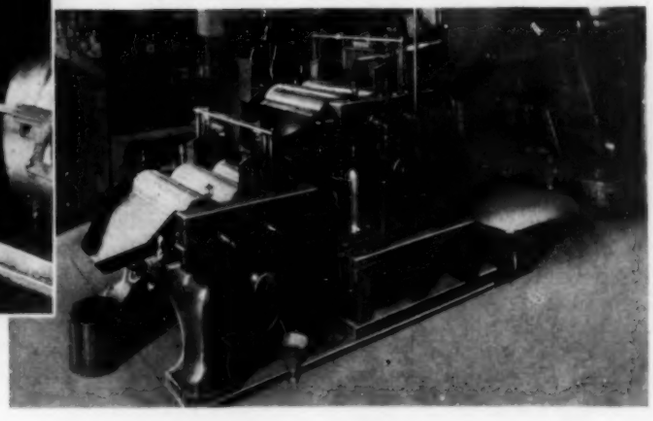
A uniform paste is made by mixing the pigment and vehicle, generally a treated linseed oil varnish. The varnish remains soft until exposed to the air, in which it dries slowly by oxidation. In this way ink made with it dries when printed, and the dried varnish acts as a binder for the pigment



The mixed paste is passed through the three-roller mill several times. When smooth it falls into shipping containers

When the batch of ink is large enough to justify it, two three-roller mills working in tandem are used to minimize handling



# BOOKSHELF

## Copper Electrometallurgy

HANDBUCH DER TECHNISCHEN ELEKTROCHEMIE. Vol. I, Part 2: Gold, Silver, Rare Metals, Copper. By *Victor Engelhardt*. Akademische Verlagsgesellschaft m.b.H., Leipzig, Germany. 331 pages. Price, 331 RM.

Reviewed by *B. H. Strom*

WITH the exception of comparatively short chapters on refining of gold and silver and a short discourse on rare metals the second volume of Dr. Engelhardt's comprehensive handbook of technical electrochemistry is devoted to the electrometallurgy of copper. Not since the appearance of Addick's "Copper Refining," a little over ten years ago, has the subject been so successfully treated. Although the art of electrolyzing copper has long ago reached a state of development where fundamental changes are not likely to occur, minor improvements have taken place during the last decade, and important additions have been made to available refining capacity.

The chapters on electrolysis with soluble anodes have been contributed by Dr. W. Schopper, of Norddeutsche Affinerie. His discourse opens with the customary treatment of the electrical and chemical phenomena of the process, composition of electrolyte, types of electrodes, electrical connections, and cell arrangements. Chapters on the treatment of anode slime and purification of the electrolyte are also included. The author goes into great detail in describing equipment and operating practice at the leading refineries in the United States and abroad, including the recently-completed Canadian refineries. An interesting description is given of a typical method of cell inspection to insure a good power efficiency. Other chapters deal with the production of starting sheets, construction of cells, and analysis of metal losses in the process. Fire refining of the cathodes, being outside the scope of the book, is referred to only briefly.

Electrolysis with insoluble anodes, a process offering interesting possibilities in the future metallurgy of copper, is ably treated by Dr. Georg Eger, of Siemens & Halske. Among the difficult problems are the selection of effective leaching solution and proper depolarizing agents. Interesting descriptions are given of the five important plants operating this process, the Chuquimata plant of Anaconda Copper; the Potrerillos plant of Andes Copper; the Ajo plant of Phelps Dodge Corp.; the Inspiration plant; and the Panda plant of Union Minière. These plants have an aggregate annual capacity of about a quarter of a million metric tons of copper.

The text is accompanied with good illustrations and many interesting charts and tables. Succeeding volumes, to appear soon, will be received with great interest.

## Nitrogen Monograph

FIXED NITROGEN. Edited by *Harry A. Curtis*. American Chemical Society Monograph published by Chemical Catalog Company, New York. 517 pages. Price, $12.

Reviewed by *R. S. McBride*

A SCIENTIFIC monograph on fixed nitrogen prepared under the editorial direction of Dr. Curtis will be widely recognized by all as an authoritative volume. This particular work, virtually a product of the Fixed Nitrogen Research Laboratory, is made up of 16 chapters, each prepared by an author who now or formerly served on the staff of that institution. It is, therefore, a monument to the prowess of that government agency quite as much as a credit to the editorial skill of its senior author and editor.

It is fitting that approximately 80 per cent of the volume should be devoted to scientific discussion of underlying principles involved in the synthesis of nitrogen compounds by arc, cyanamide, cyanide, or direct-synthetic methods. Fortunately the treatment has been consistently that of the scientist, not primarily that of either the engineer or the economist. Thus there remains a sound and enduringly useful fund of information that need not be discarded in the near future simply because of changing economic relationships or modified industrial processes. Particularly will such chapters as that by Kunsman on the study of catalyst surfaces long endure as a valuable reference source in scientific libraries.

Although basically scientific in its character, the volume is at the same time eminently a practical one. At no time need the reader fear that he will find himself gaining a distorted industrial perspective from the use of the book. The wide technical experience of the editor and the various chapter authors has insured that a nice balance is maintained within each division, making the treatment proportionate to the real importance and the industrial significance of the subjects treated.

The volume should have wide usefulness. Agronomists, members of the fertilizer industry, and technologists, will all welcome the work almost as heartily as will research and development engineers and scientists. The reviewer heartily commends the work to all groups who have any interest in nitrogen, pure or applied.

## The Soap Industry

THE MODERN SOAP AND DETERGENT INDUSTRY. By *Geoffery Martin*. D. Van Nostrand Company, New York. Two vol., total 763 pages. Price, $24.

Reviewed by *Harvey G. Elledge*

AS a review of the soap and detergent industry, this book includes a discussion of the nature of soap and detergent action and a description of the raw materials such as fats and rosins, alkalis and perfuming materials used in this industry. The divergency of processes employed to produce soaps for the household, power laundry and textile industries and general cleansers are in turn discussed in an historical and descriptive manner.

The book will prove to be useful for student and instructors in industrial chemistry; the practical man in the soap industry will find some very helpful information. However, some of the mentioned methods are more of historical interest. The veteran soap maker, with his calloused tongue will be pleased at seeing in print his approved test for complete saponification. Also the more recent and approved chemical control methods receive adequate treatment.

The section dealing with general properties and theories of the detergency of aqueous solutions of soaps, are excellently written and comprehensively cover and interpret the literature on these subjects with due recognition of the extensive work of McBain and his co-workers.

Subsequent sections of Volume I on the manufacturing procedure do not reveal intimate acquaintance with modern American factory layouts. Also in the description of the important alkali, caus-

tic soda, the author fails to mention some of the more recent developments in the distribution of this important material. The author's chapter on wool soap does not agree with more recent claims as to the relative merits of sodium soaps as compared with potassium soaps in textile processing.

The division of the text into sections, each with a separate series of page numbers, makes for confusion in the use of the index. In Vol. 2, "Hypochlorides" is used instead of "Hypochlorites," but otherwise the proof reading has been well done. On the whole, the book is recommended for perusal to anyone interested in the technical aspects of the soap and detergent industry.

## Vegetable Fats

VEGETABLE FATS AND OILS. By *George S. Jamieson.* The Chemical Catalog Co., Inc., New York. 444 pages. Price, $6.50.

Reviewed by *S. Józsa.*

ADMIRABLY summarizing the most reliable work carried out in the field of fats and oils, this latest addition to the series of American Chemical Society monographs is a reliable reference source for any technical or research laboratory. As chemist in charge of the oil, fat and wax laboratory in the Bureau of Chemistry and Soils, U. S. Department of Agriculture, the author has a perspective of this subject which enables him to evaluate in an understanding manner what should be included in a reference book of this kind. All readers will immediately recognize his encyclopedic knowledge of his subject and will approve of the thorough and detailed, yet compact, manner in which this knowledge is made available.

Lewkowitsch's system is followed in dividing the oils into non-drying, semi-drying and drying oils. A generous chapter is given to fatty acids, alcohols, sterols, hydrocarbons, phosphatides, and analytical and plant control methods. Adulterants of these fats and oils and methods of detecting them are included. Specific bibliographies, listed in the body of the text for each fat, add to the value of the book. A useful appendix including tables, index of botanical nomenclature, and subject index, gives completeness to the monograph.

## Problems in Metallurgy

TEXTBOOK OF METALLURGICAL PROBLEMS. By *Allison Butts.* McGraw-Hill Book Company, New York, N. Y. 425 pages. Price, $4.

ACCORDING to the author's introductory remarks, the main purpose of this book is to fill a long-felt need for a textbook for the college student. Although not intended to replace Joseph W. Richard's classic, "Metallurgical Calculations," written principally for the practicing metallurgist, it contains much new and revised data necessary lacking in the earlier book, last edition of which appeared in 1918. Those accustomed to the use of Prof. Richard's book should therefore also find the new work a valuable addition to their books.

Application of thermodynamics to chemical and metallurgical reactions, a subject given little attention 10 to 15 years ago, is now arousing sufficient interest to warrant an introductory treatment in the last chapters of the book. Among other subjects dealt with are combustion, heat balance, hydrometallurgy and electrolytic processes; distillation processes, and transmission of heat.

Of the problems used throughout to illustrate the various subjects, many represent actual operating conditions at stated plants. Although not intended as a source of definite information as to the actual practice of these plants, such a treatment should not fail to stimulate the interest of its readers.

FARADAY AND HIS METALLURGICAL RESEARCHES. By *Sir Robert A. Hatfield.* The Penton Publishing Company, Cleveland, Ohio. 329 pages. Price, $6.50.—Within a rather specialized scope this work has the merit of presenting some of the great scientist's early work on special alloys, particularly remarkable for its affinity with work of the present day.

THE BOOK OF METALS. By *Donald Wilhelm.* Harper & Bros., New York City. 341 pages. Price, $4—As any of Mr. Wilhelm's past audience well know, this book will lean less to the technical side than to its popular antecedent, "The Book of Knowledge." In fact the author is at great pains to avoid any imputation of technical intent, and thus proceeds to tell the "stories" of the important metals in rather romantic vein. He has had the assistance of leading companies in his field and often reduces his story to their own history. It cannot be recommended to a technical man or even a serious student, but the relaxing business and lay man should get considerably more amusement and reliable instruction from its perusal than from an equivalent session with his radio.

ABEGG'S HANDBUCH DER ANORGANISCHEN CHEMIE. Vol. 4, Section 3, IRON SALTS. By *R. Abegg, S. Auerbach* and *I. Koppel.* Verlag, S. Hirzel, Leipzig, Germany. 210 pages, Price, 24 RM.—This newly appeared division of Abegg's large section on iron, covers the manifold and complex cyanide salts.

## Materials of Construction

DIE WERKSTOFFE DER CHEMISCHEN APPARATE. By *H. Freytag.* Verlag Chemie, G.m.b.H., Berlin. 54 pages. Price, M.2.80.—In an industrial era that is energetically occupied with corrosion, this booklet stands out by virtue of its compact and concentrated usefulness. After an introductory listing of useful construction alloys, according to their constituents, it presents in outline form the important groups of corrosive agents with a stenographic list of recommended, usable, and unsatisfactory materials. Of the two main divisions of reagents, inorganic and organic, the former includes such a comprehensive range as the atmosphere, water, mine waters, acids and alkalis, gases, explosives, and fused salts and metals. It is to be hoped that an English version will soon make its appearance; even so, any one with a smattering of German can satisfy his inquiries, especially because the data, despite their brevity, cover all variations of practical experience.

SYMPOSIUM ON RUBBER. American Society for Testing Materials, Philadelphia, Pa. 160 pages. Price, $1.75.—12 papers presented at a divisional meeting of the society in March, covering manufacture of rubber products and properties of rubber as an engineering material.

## Reference Works

MINERAL RESOURCES OF THE UNITED STATES, 1929. Part I, Metals; Part II, Non-Metals. Published by U. S. Bureau of Mines; for sale by Superintendent of Documents, Washington, D. C. 968 and 858 pages. Price, $1.50.—This 47th report of an annual series, parts of which have been published separately before, covers the somewhat insubstantial era of 1929. Probably this fact, representing activities in their greatest boom, will make this issue more than ever a valuable reference work.

BIBLIOGRAPHY OF PAPERMAKING and United States Patents on Paper making and Related Subjects, 1931. Published by Technical Association of the Pulp and Paper Industry, New York. 175 pages. Price, $2.—Divided into two main sections, according to the title, and sub-divided according to subjects.

CHEMICAL ENCYCLOPEDIA, By *C. T. Kingzett.* 5th Edition. D. Van Nostrand Co., New York. 1,014 pages. Price, $10. In its previous editions this handbook has had the distinction of always yielding some helpful information on any subject. This feature has been

capitalized in the present edition, with its increase of over 200 pages and innumerable items. On the other hand it must be said that the information is frequently incomplete and not wholly authoritative. This, it would seem, should be the author's next concern in keeping the encyclopedia alive, because it represents so useful a blend of the theoretical and practical otherwise.

COMBUSTION—A REFERENCE BOOK ON THEORY AND PRACTICE. Third edition. Published by American Gas Association, New York. 208 pages. Price, $2.

THIS volume is an extremely valuable handbook on fuel utilization, particularly the application of gas in industrial heating. It deserves far wider recognition and more frequent use among chemical engineers than has been accorded earlier editions. The revised volume is really an entirely new book covering technical and economical considerations of heat measurement, combustion, heat transfer, industrial gas burners, industrial furnaces, temperature control, heat recovery, gas analysis, and other related fields. The volume has been prepared by C. George Segeler, industrial editor, working under the direction of the special committee of the Industrial Gas Section of A.G.A. A carefully edited and altogether authoritative work, it can be cordially recommended to all in industry who have fuel problems, and thus virtually to every chemical engineering organization.

HOVER-KREUTER TECHNOLOGICAL DICTIONARY. 6th Edition. Edited by *A. Schlomann*. Verlag Julius Springer, Berlin; American agents, The Industrial Press, 148 Lafayette St., New York. 3 vol., about 800 pages each. Price: 3 vol., $55; 2 vol., $37.50; 1 vol., $19.50.—Backed by the leading technical societies and industries in Germany, this revision represents a new peak in technical lexicography, where so much good prior publication has been done. The three languages indexed, English-German-French, each form the key or entry in one of the three volumes with the other two as the definition. Chemical terms are very competently covered in the 100,000 key words, and an absence of the usual awkwardness in translation makes it probably the most universally useful work for engineers coping with the other languages. Printing and book-making add to the general attractiveness of the publication.

MOTOR BENZOLE, Its Production and Use. By W. H. Hoffert and G. Claxton. National Benzole Association, London. 1931. 689 pages.—This volume is largely descriptive of the elementary principles underlying benzol recovery, the sources of benzol, the methods of plant operation characteristic of British plants for recovery, distillation, and products manufacture. Those particularly interested in benzol production or its use for motor-fuel blending will find a great deal of information regarding British practice; comparatively little in the volume relates directly to American conditions or methods.

## GOVERNMENT PUBLICATIONS

*Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.*

*Montecatini's Earnings and Operations in 1931*, by A. A. Osborne. Bureau of Foreign and Domestic Commerce, Chemical Division Special Circular 374; mimeographed.

*Iron Oxide Pigments and Mortar Colors*, by R. M. Santmyers. Bureau of Mines Information Circular 6627; mineographed.

*Motor-Gasoline Survey*, August, 1931. Part II—Additional Data, by A. J. Kraemer and others. Bureau of Mines Report of Investigations 3175; mimeographed.

*Properties of Crude Oil From the Greasewood Flat Area in Colorado*, by H. P. Rue. Bureau of Mines Report of Investigations 3174; mimeographed.

*Transportation of Gasoline by Pipe Line*, by C. P. Bowie. Bureau of Mines Technical Paper 517; 10 cents.

*Contributions to the Data on Theoretical Metallurgy.* I. The Entropies of Inorganic Substances, by K. K. Kelley. Bureau of Mines Bulletin 350.

*The Ignition of Fire Damp by Explosives*, by W. C. F. Shepherd. Bureau of Mines Bulletin 354. A study of the process of ignition by the Schlieren Method.

*Consumption of Silver in the Arts and Industries of the United States*, by Charles White Merrill. Bureau of Mines Economic Paper 14.

*Molybdenum*, by Alice V. Petar. Bureau of Mines Economic Paper 15; 10 cents.

*Mineral Production Statistics, 1930.* Final printed separate from the Bureau of Mines on: Zinc, by Elmer W. Pehrson; 5 cents.

*The French Iron and Steel Industry and Trade*, by Thomas Butts. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 800; 10 cents.

*Glossary of Paper Terms and Instructions to Exporters.* Bureau of Foreign and Domestic Commerce unnumbered pamphlet.

*Waxed Tissue Paper.* Bureau of Standards Simplified Practice Recommendation R-125-31; 10 cents.

*The Optical Rotation of Liquids*, its Variation With Wave Length Temperature, Solvent and Concentration, by T. Martin Lowry. Bureau of Standards Miscellaneous Publication 118.

*American Fertilizers*, by P. E. Howard. Department of Agriculture Miscellaneous Publication 143; 10 cents.

*Cocoa By-Products and Their Utilization as Fertilizer Materials*, by G. P. Walton and R. F. Gardiner. Department of Agriculture Department Bulletin 1413; 10 cents.

*Hydrocyanic Acid Gas as a Fumigant* for Destroying Household Insects, by E. A. Back. Department of Agriculture Farmers' Bulletin 1670; 5 cents.

*Loose Smut in Barley and Its Control by Dust Fungicides*, by R. W. Leukel. Department of Agriculture Technical Bulletin 293; 5 cents.

*Minerals Production Statistics for 1931*—Preliminary mimeographed statements from Bureau of Mines on: salt, bromine, and calcium chloride; iron and steel industry; abrasive materials industry; copper; lead; lead and zinc pigments and zinc salts; world production of natural gasoline; emulsified asphalt; Indiana oolitic limestone; feldspar aluminum.

*Production Statistics From 1931 Census of Manufactures*, in preliminary mimeographed form for: pyroxylin plastic; baking powders, yeast, and other leavening compounds; corn syrup, corn sugar, corn oil, and starch; linoleum and asphalted-felt-base floor covering; malt; matches; chewing gum; cane-sugar refining; artificial leather; oilcloth; fuel briquettes; pulpwood consumption and wood-pulp production for identical mills 1931, 1930, and 1929.

*Seasonal Trends of Rubber Production.* Bureau of Foreign and Domestic Commerce, Trade Information Bulletin 804.

*Tung Oil*, by C. C. Concannon. Bureau of Foreign and Domestic Commerce Trade Promotion Series 133.

*Motor Fuels in Foreign Countries.* Bureau of Foreign and Domestic Commerce, Trade Information Bulletin 805.

*The Chemical Industry and Trade of Brazil.* Bureau of Foreign and Domestic Commerce, Trade Information Bulletin 807.

*The Leather Industry and Trade of Belgium*, by Trade Commissioner Walter Hertz. Bureau of Foreign and Domestic Commerce, Trade Information Bulletin 806.

*Annual Supplement to Survey of Current Business*, 1932. Bureau of Foreign and Domestic Commerce; 25 cents.

*Past Accomplishments and the Outlook for the Soviet Chemical Industry.* Bureau of Foreign and Domestic Commerce, Russian Economic Notes No. 181; mimeographed.

*Sampling and Estimation of Ore Deposits*, by Chas. F. Jackson and John B. Knaebel. Bureau of Mines Bulletin 356.

*High-Manganese Slags* in Relation to the Treatment of Low-Grade Manganiferous Ores, by C. H. Herty, Jr., and others. Bureau of Mines Technical Paper 523.

*Use of Lime in a Salt Solution for Removing Hydrogen Sulphide From Natural Gas*, by Harold P. Rue. Bureau of Mines Report of Investigations 3178; mimeographed.

*Inflammability of Mixed Gases:* Mixtures of Methane, Ethane, Hydrogen, and Nitrogen, by G. W. Jones and R. E. Kennedy. Bureau of Mines Report of Investigations 3172; mimeographed.

*Natural-Gasoline Plants in the United States*, Jan. 1, 1932, by G. R. Hopkins and E. M. Seeley. Bureau of Mines Information Circular 6635; mimeographed.

*Economic Factors Influencing the Domestic Demand for Gasoline:* Part I, Revenue Motor Buses, by H. A. Breakey and E. B. Swanson. Bureau of Mines Information Circular 6639; mimeographed.

*Migration of Injected Gas Through Oil and Gas Sands of California*, by H. C. Miller. Bureau of Mines Report of Investigations 3177; mimeographed.

*Summarized Data of Tin Production*, by John B. Umhau and others. Bureau of Mines Economic Paper 13.

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*Mineral Production Statistics for 1931*—preliminary mimeographed statements from Bureau of Mines on: platinum and allied metals; gypsum; phosphate rock; petroleum, petroleum products, and natural gasoline; asphalt; asbestos; arsenic, bismuth, selenium and tellurium; mica.

*Production Statistics From 1931 Census of Manufactures* in preliminary mimeographed form for: Linseed oil, cake and meal; soap; explosives; rubber tires and inner tubes; rubber boots and shoes.

*Products of Manufacturing Industries 1929.* Bureau of Census Distribution No. I. G. 201. A summary of production statistics from the 1929 Census of Manufactures, with a complete commodity index.

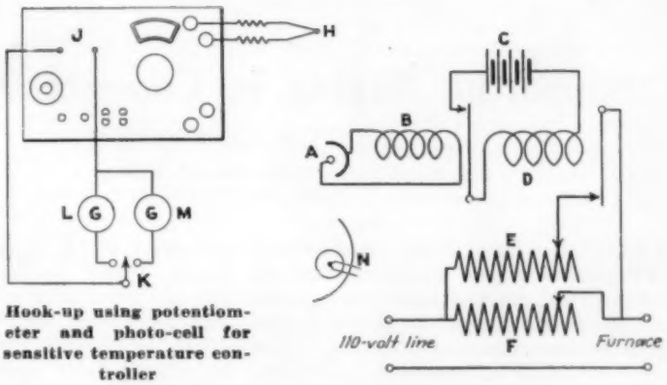
*Domestic Value-Conversion of Rates.* U. S. Tariff Commission Report No. 45, Second Series. Tabulation of the ratio of tariffs to domestic value of imported goods.

*Regulation of Tariffs in Foreign Countries by Administrative Action.* U. S. Tariff Commission unnumbered pamphlet, Miscellaneous Series.

# PLANT NOTEBOOK

## Temperature Controller Uses Photoelectric Cell

By R. H. NEWTON and C. C. FURNAS
*Respectively Instructor and Associate Professor of Chemical Engineering, Yale University*
*New Haven, Conn.*




**Hook-up using potentiometer and photo-cell for sensitive temperature controller**

MOST of the apparatus needed in the construction of a very sensitive form of temperature controller that has been built and used by the Department of Chemical Engineering at Yale can be found in the average plant or laboratory, or purchased for a few dollars. The total new expense can probably be covered by an outlay of $30-$40. The controller is simple to set up and keep in adjustment, is capable of considerable variation both in the type of detecting element used, and in the method of applying the control, and can be made to give a possible accuracy limited only by the accuracy of the detecting element and the lag inherent in the furnace.

In brief, light reflected from the mirror of a galvanometer which is used in a potentiometer circuit connected to the detecting device is caused to play over the surface of a Weston Photronic cell. The cell, in turn, actuates relays which control the heat supply, either fuel or electricity. The detecting device may be a single- or multiple-junction thermocouple or a resistance thermometer and it is probable that the circuit can be adapted to the use of a radiation pyrometer or other apparatus which employs a potentiometer.

The hook-up used in the apparatus built at Yale is illustrated in the accompanying figure. The furnace in this case was made for heating a methanol catalyst to a temperature of 250-350 deg. C. The furnace had a total resistance of 41 ohms and was connected, as shown, in series with two slide-wire resistances in shunt, the resistance of $E$ being 4.5 and of $F$ 11.5 ohms. The mirror galvanometer, $M$, was connected into the circuit of the portable potentiometer, $J$, which measured the emf. of the Chromel-Copel thermocouple, $H$, in the furnace. For convenience in reading the temperatures, a second needle galvanometer, $L$, was provided, to be connected in momentarily by means of switch, $K$.

The light from a 32-c.p. bulb in an automobile headlight, $N$, was focussed on the mirror of the galvanometer, $M$. The angles were chosen so that when the galvanometer was balanced, the light reflected from the mirror would not fall on the Photronic cell, $A$, but would do so when the circuit became unbalanced on the cold side. A stop was arranged back of the mirror to prevent the beam of light from passing beyond the cell so that for all temperatures below the operating temperature, the beam would remain on the face of the cell and maintain the relays, $B$ and $D$, closed.

The Photronic cell developed sufficient voltage to actuate the sensitive relay, $B$, which would operate on about 200 microamperes. The working relay, $D$, operated on the 6-volt battery, $C$, and was capable of making or breaking a circuit of 100 watts. If it had been desired to increase the working current, a mercury relay might have been substituted, or a third relay used to increase the current carrying capacity to several kilowatts. In the case given, resistance, $E$, was cut in and out by the action of $D$, shunting $F$ and increasing the current through the furnace whenever the galvanometer moved to the cold side. With a galvanometer sensibility of 9 megohms,* a distance of 1 ft. from the mirror to the light source and cell, and a cell diameter of 2 in., a shift in illumination of about $\frac{1}{8}$ in. on the surface of the cell would cause the relay, $B$, to function.

In operation, as soon as the temperature, as measured by $H$, rose above the set point, the beam of light left the cell surface, causing the relays to open and disconnect shunt, $E$. Accurate records taken with a recording potentiometer connected to a second thermocouple showed a maximum variation of 0.05 mv. or about 1 deg. C. Had it not been for the lag in the furnace, it would have been possible to control as closely as 0.005 mv. or about 0.1 deg. C. Obviously, with the lag the limiting factor, it would not have been worth while to increase the sensitivity of the controller, although this could have been done in several ways such as employing a multiple-junction thermocouple or a more sensitive galvanometer. The operating angle of the galvanometer could have been decreased by increasing the distance from the mirror to the cell, requiring, however, a more nearly parallel beam of light to actuate the cell. Or, without increasing the intensity of the light, it would have been possible to illuminate the cell continuously just below the threshold intensity for throwing the relay so that less light would be needed from the galvanometer mirror.

*A sensibility of 9 megohms means that a current of 0.000000111 amp. will give a 1 mm. deflection on a scale 1 meter distant.

## Descaling Copper Surfaces

By A. P. HARRISON
*Tacoma Park, Md.*

IT IS customary in certain industries to cool tanks of liquid by means of the evaporation of films of water running down the sides of the vessels. This cooling water, over a period of time, is likely to deposit a film of scale of considerable thickness on the sides of the tanks, mitigating to a large extent the cooling effect of the water.

The deposit on the walls of copper tanks adheres very tightly and is difficult to remove by mechanical scraping.

It appears primarily to be an iron oxide. Acids and caustic alkalis may be used to remove the scale but are dangerous, partly because of their action on the copper, but especially because of danger to the workmen.

Saturated ammonium chloride solution poured over the scale while the tank is steaming hot will penetrate through the scale and lift it off the copper surface, after which a strong stream from a hose nozzle will knock it off. By employing appropriate technique, this method proves more satisfactory than mechanical scraping or the use of strong chemicals, both from the standpoint of safety and of economy. Ammonium chloride is relatively cheap, only slightly acid and safe to handle. Properly manipulated, it will do a good job.

# Supporting Piping in Concrete Trenches

By BERNARD KRAMER
*Consulting Mechanical Engineer*
*Pittsburgh, Pa.*

WHEREVER it is conveniently possible to do so, piping around chemical and other manufacturing plants is supported overhead or buried underground, but occasionally certain pipes must be located in concrete trenches constructed inside and outside buildings. In inside trenches, the top of the trench is usually level with the floor and is covered with removable checkered plates. Outside trenches commonly extend 6 in. above ground level to prevent surface water from flooding the trench during rainy weather. They are covered with boards cleated together into removable sections. In some of the more up-to-date plants both inside and outside trenches are covered with removable checkered plates.

The pipes in the trench must never be too crowded. There must be sufficient working room for tightening joints and making other repairs or alterations. A distance of 12 in. from the center line of pipes to the inside of the trench wall is sufficient for pipe sizes up to and including 10 in. The center-to-center distance of pipes placed one above the other should be enough to allow flanges to pass one another; for instance 8-in. and 10-in. pipes with standard flange diameters of 13½ in. and 16 in., respectively, should be spaced not less than 14¾ or 15 in. center-to-center, while 4-in. and 5-in. pipes with flanges 9 in. and 10 in. in diameter, respectively, should be at least 9½ in. apart.

A satisfactory and economical method of supporting pipes in trenches is shown in Fig. 1. The two rows of pipes are placed along the trench walls with a working aisle in the center. This aisle should never be less than 18 in. wide in the clear, and should be wider for larger pipe sizes. The pipes are hung by U-bolts from 4-in. x 7.5-lb. I-beams spaced 16-18 ft. apart all along the trench. The beams rest in pockets especially provided for them in the trench walls so that the top of beam is about 2 in. below the trench cover. The beams are subsequently grouted in.

Each pipe must hang from the I-beam individually. Never support one pipe from another. If possible locate the larger pipes lower in the trench and the smaller pipes above them. In any case, the U-bolts supporting all the pipes except the ones near the top of the trench must be spread to allow for removal of the upper pipes, or any portions of them, without disturbing the pipes below. The clips, details of which are shown in the enlarged section, may be fabricated in the shop and drilled as shown for ½-in. or ⅝-in. U-bolts, so that the only parts on which field work must be performed are the U-bolts themselves, their length being determined in place. Adjacent clips are placed on opposite sides of the I-beam, as shown in the section, to avoid eccentric loading.

A smaller number of pipes may be arranged in one row. For a larger number, three rows and two working aisles are arranged. Connections from storage tanks or other equipment are made on the side as in Fig. 2. Such connections can swing on two screwed joints to allow for any inaccuracy in the setting of the tanks or in the location of the pipe nozzles, or for expansion and contraction of the line.

These remarks relate only to comparatively short stretches of pipe trench inside or outside buildings, between the storage tanks and pumps, or in any place where special provision need not be made for expansion and contraction. Where any pipe line requires a slip expansion joint, such a line should rest on V-shaped rollers (Fig. 3) placed on the trench floor or on brackets in order to preclude any possibility of lateral movement in the line. The expansion joint should be of the anchor type, and must be attached securely to the floor or wall of the trench.

All pipe lines in a trench should be made to slope uniformly to some convenient low point which is to be likewise the low point of the sloping trench floor. A sump is constructed at this point and into it any line may be drained when not in operation or when repairs are to be made. From it the contents may be siphoned or pumped into the proper tank. The sump should be lined, if necessary, with resistant material capable of withstanding the action of any of the liquids that may be drained into it from the pipes in the trench.

**Fig. 1—(Left) Inside pipe trench showing method of constructing and attaching hangers**

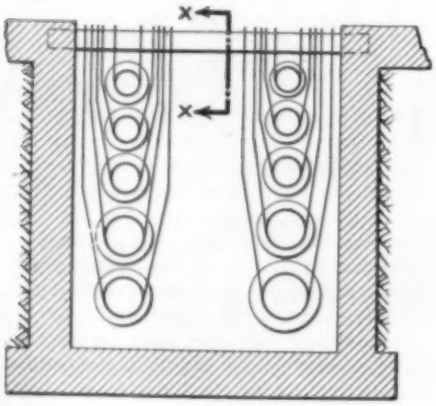



**Fig. 2—(Right center) Outside trench illustrating side connection to permit pipe expansion**

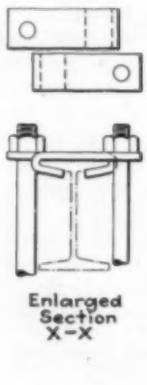
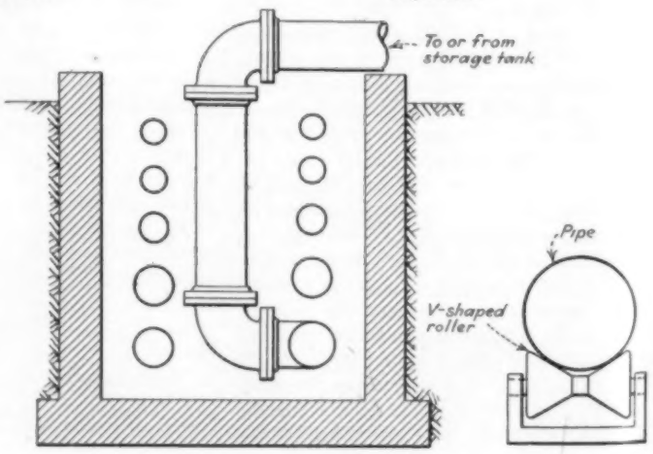



**Fig. 3—(Right) V-shaped roller suitable for supporting pipes subject to expansion**



# NEW EQUIPMENT

**Metal and Alloy Developments • Rotojector Centrifugal • Improved Solids Pump • Novel Colloid Mill • Steel Apron Conveyor • Standard Fluid Meters • Gooseneck Immersion Heater • Improved Acid Pumps • Volatile-Liquid Pumps • High-Intensity Separator • Demountable Return Bends • Gear Motors • Boric Acid Fuses • Flexible Air Separator • Industrial Electric Oven • High-Capacity Screens • Self-Acting Temperature Regulator • Metal Clad Insulating Panels • Manufacturers' Latest Publications**

## Metal and Alloy Developments

AMERICAN Rolling Mill Co., Middletown, Ohio, has announced an improved enameling iron, known as "Crystal Etched" which is said to possess exceptional bonding qualities. On this account the metal is reported to give greater resistance to chipping and flaking. It is claimed to give improved reboiling behavior.

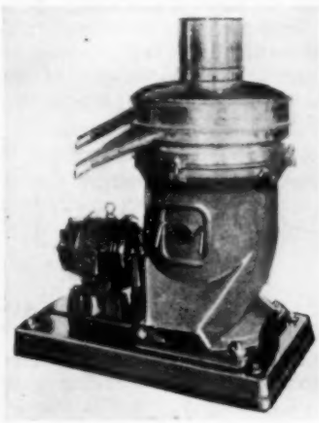
Resistance to the sea water was the primary object in the development of P-M-G Metal which is now being made by the Phelps Dodge Copper Products Corp., 40 Wall St., New York City. The new alloy is a bronze said to be superior both in physical properties and corrosion resistance to existing alloys of the tin-bronze type. In addition to its salt-water resistance the metal is said to be suitable for use with many other corrosive agents. It is also resistant to abrasion and capable of successful application at temperatures as high as 1,000 deg. F.

The Cooper Alloy Foundry Co., 150 Broadway, Elizabeth, N. J., has recently broadened the scope of its operations to include high tensile and pressure castings of low-chrome and chrome-nickel steels. Driver-Harris Co., Harrison, N. J., has been licensed by the International Nickel Co., to melt and fabricate the corrosion-resisting alloy-cast-iron, Ni-Resist, a nickel-copper-chromium cast iron suitable for moderately high-temperature and corrosion-resisting applications.

## Rotojector Centrifugal

CLARIFICATION and separation capacity up to 700 gal. per hour is provided by the new Rotojector centrifugal recently announced by the Sharples Specialty Co., 501 Fifth Ave., New York City. This machine makes possible the application of very high centrifugal force, while at the same time, it is capable of unloading settled solids in 10 seconds while operating at full speed. The machine is intended for clarification of liquids containing up to 10 per cent of amorphous and slurry precipitates and the clarification of liquids where the cost of bowl cleaning would otherwise be a serious item. It is also adapted to the separation of liquids containing up to 10 per cent of solids by volume, the reclaiming of valuable liquids held in slurries and the removal and recovery of valuable sludges.

**Discharge side of centrifugal**



The Rotojector principle incorporates a special construction of bowl, consisting of an inner bowl sliding within a casing to uncover an annular slot for the discharge of solids while the bowl is running at full speed. Normally this slot is closed by the action of springs, but it is opened when desired by the hydrostatic pressure in a layer of water charged into a special space in the bowl. This pressure is generated by the rotation of the bowl and suffices quickly to accomplish the desired discharge. The machine weighs 930 lb. and requires a 3-hp. driving motor.

## Improved Solids Pump

REDESIGNING its standard Fuller-Kinyon pump for the transportation of pulverized solids, the Fuller Co., Catasauqua, Pa., has announced the Type F machine for which low first cost and operating costs are claimed. It is stated that the improved model is capable of operating on air pressures ranging from 10 to 20 lb. per square inch, that in small installations its first cost compares favorably with mechanical conveying methods and that in long installations first cost is considerably less.

The new conveyor is similar in principle to the company's earlier solids pumps, described on pages 208 and 209 of the April, 1930, issue of *Chem. & Met.* Changes consist largely in refinements and simplifications in the design through which it is possible to utilize unusually low pressure air. Operation, it will be recalled, depends upon mixing the solids to be pumped with air, when, in this thoroughly aerated condition, the material can readily be forced through a pipe. Motive power is supplied by a screw.

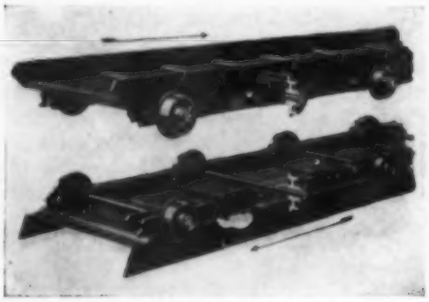
## Novel Colloid Mill

HIGH CAPACITY, thorough emulsification and low operating cost are said to be outstanding features of the Zenith Emulsifying Machine recently introduced into this country by Th. Goldschmidt Corp., 68 Beaver St., New York City. The Zenith mill will handle small production capacities from 100 to 200 gal. per hour and is constructed on what is described as the new

principle of bringing the two immiscible ingredients of the emulsion together at the point of maximum hydraulic shear and agitation. The mill is built like a small centrifugal pump, the ingredients being introduced through separate feed pipes into the center of the impeller. Five stationary pegs in the casing clear the impeller by reason of slots cut in the blades. The material, as it flows outward through the impeller, passes the pegs and is subjected to violent forces which result in emulsification. Depending on which feed pipes are chosen for the ingredients, either one may be made the external phase of the emulsion.

## Steel Apron Conveyor

COMPLETE freedom from leakage of material, combined with sufficient flexibility to enable the conveyor to travel evenly and without strain around the sprockets, is a feature of the new "Gravity Seal" steel apron conveyor manufactured by the Webster & Weller Manufacturing Cos., 1856 North Kostner Ave., Chicago, Ill. The "Gravity Seal" feature is based on a new method of attaching the conveyor pans to the

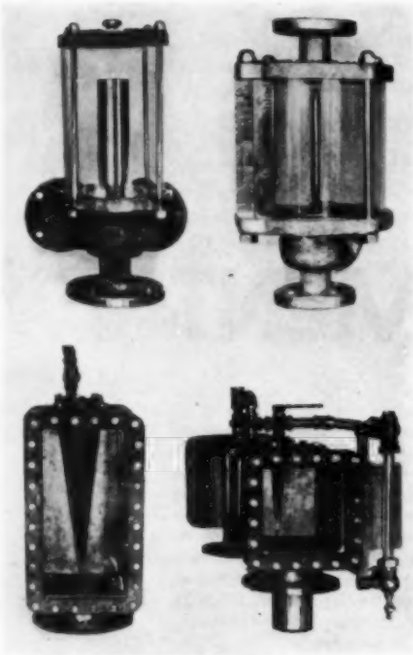


**Construction details of improved conveyor**

chain by means of a special pivot link. As a result of this construction the pans overlap very snugly. The new construction is also applicable to apron feeders and has been developed primarily to withstand the abrasive action of cement materials, coke, sintered minerals, and so on.

## Standard Fluid Meters

VULCAN Copper & Supply Co., 120 Sycamore St., Cincinnati, Ohio, has developed a line of indicating liquid meters, employing weirs, orifices and slots as the measuring devices. Typical examples of these meters, which, depending on the style, are available in capacities up to 5,000 gal. per hour, are shown in the accompanying illustration. The four types indicated are illustrative of the entire line. The upper right meter employs an orifice in the base plate, together with a vertical vent tube. The upper left uses a slotted vertical tube with calibration marks on the tube. Of



**Indicating flow meters using weirs, orifices and slots**

the models illustrated below, the one at the left uses a simple, calibrated V-notch weir, while that at the right has added a sight glass for ease in reading the level at the weir. In all cases, particular care is taken to insure quiescent flow with consequent accuracy of level readings. Meters are available in a wide variety of metals and are supplied with individually determined calibration charts.

## Gooseneck Immersion Heater

MOUNTING electric immersion heaters by hanging them over the side of the bath or container is facilitated by a new construction developed by the Harold E. Trent Co., 618 North 54th St., Philadelphia, Pa. This is a modification of the company's regular strip heater which consists in extending the tubular casing at the terminal end to form a semi-flexible riser without any joint in the casing. This riser can be bent to form a gooseneck, either to clear the wall of the container or to support the unit in the bath. These heaters are supplied with casings of copper, Stainless steel or other alloys, or lead-covered when desired.

## Improved Acid Pumps

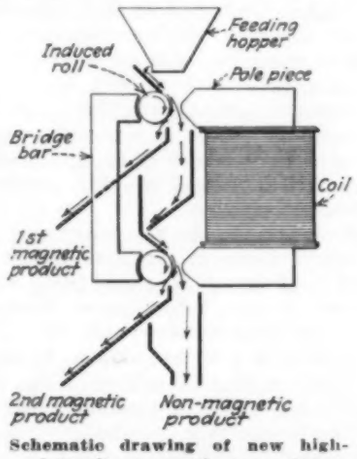
AN ANNOUNCEMENT made by Oliver United Filters, Inc., 33 West 42d St., New York City, describes improvements recently effected in the line of Olivite acid pumps made by this company. The pump is now made in a modified design, providing for circulating solution on the packing gland in place of grease, if grease is not desired. The shaft of the pump is now anchored to the impeller by a longitudinal tierod extending through its axis. The sleeve on the shaft is attached to it more substantially. Arrangements for the adjustment of packing and packing glands have been further simplified.

## Volatile-Liquid Pumps

APPLICATION of the principles of gas-compressor design to the construction of a line of improved, direct-acting steam pumps known as the "HiVol" series has been announced by Worthington Pump & Machinery Corp., Harrison, N. J. The pumps are intended for very volatile liquids and are built with a very small clearance volume to prevent excessive agitation of the liquid in the cylinder with consequent release of vapor. Among design features may be mentioned the fact that the valves are all located in the end of the liquid cylinder, the latter being lined with a removable Ni-Resist liner designed for 400 lb. working pressure.

## High-Intensity Separator

ALTHOUGH it may not be generally known, there are some 40-odd minerals in addition to iron that are magnetic to a certain degree. Prior to the development of high-intensity magnetic separators, most of these materials could not be separated with the equipment then available. Dings Magnetic Separator Co., Milwaukee, Wis., has announced its new Type IR separator



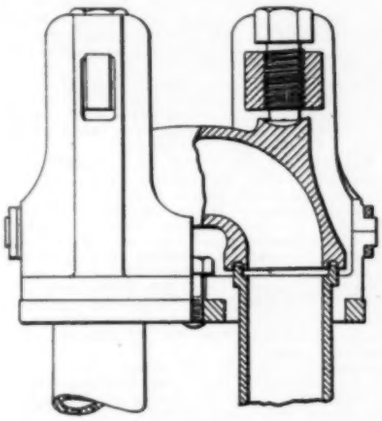

**Schematic drawing of new high-intensity magnetic separator**

which has successfully removed slate from coal, mica from feldspar, iron oxide from bauxite, etc. The accompanying diagram shows the principle of the new separator. Interposed between the poles of a large electromagnet and the bridge bar or keeper are laminated rolls. Due to the design, the lines of magnetic force are concentrated almost completely in the two air gaps between the rolls and the magnet pole pieces. Material to be separated clings

to the rolls until the lines of force have reversed at the bottom dead-center, whereupon separated material drops off and is carried away by a chute. Such machines are said to have a capacity as high as 8 tons per hour. In the actual equipment, material is subjected to four passes over the rolls before discharging to the non-magnetic tailings chute.

## Demountable Return Bends

UNDER the same title, in its issue of August, 1929, *Chem & Met.* described the first of a now complete line of header box assemblies for petroleum stills introduced by the Stockham Pipe & Fittings Co., Birmingham, Ala. The complete line now includes a number of



New scissors-type return bend

new varieties of demountable return bends of which the Type SPR, a scissors type, is illustrated herewith. Referring to the drawing, it will be noted that this type slips over the upset tubes without requiring sectional rings, acting as a pair of tongs and pulling the tubes into place. Other varieties of return bend offered include types for low pressure which use threaded tubes; types with tubes rolled in; and sectional headers which also have the tubes rolled in.

## Gear Motors

INTERNAL, helical-planetary-gear speed reducers, built integral with the frame of a normal-speed motor are available in a new line of gear motors recently put on the market by General Electric Co., Schenectady, N. Y. Compact construction, high efficiency and full horsepower ratings of the motor at the output shaft are features of the design. These motors are made in a wide variety of types, including alternating- and direct-current, adjustable-speed, totally inclosed and totally inclosed, fan-cooled. Depending on the type, motor ratings as high as 75 hp. may be obtained. Standard gear motors can be had with the shaft speed as low as 13 r.p.m.

## Boric Acid Fuses

WESTINGHOUSE Electric & Mfg. Co., East Pittsburgh, Pa., has recently developed an interesting application for boric acid. In the center of a thick-walled cylinder of solid boric acid is a plunger which would be withdrawn deep into its hole by a spring were it not held forward by the fuse wire which serves as one terminal. When the fuse melts, the arc is drawn down into the boric acid hole, causing an outrush of water vapor which instantly extinguishes it. One of the most striking features of this fuse lies in the fact that it was developed along lines diammetrically opposed to those previously attempted. Formerly, it was thought that the arc should be surrounded by materials which would evolve no vapor. In the new fuse, however, boric acid has been used because it yields a maximum volume of non-explosive vapor. The new design is equally suitable for interrupting both large and small currents.

## Flexible Air Separator

CULMINATING a period of systematic research, The Sturtevant Mill Co., Boston, Mass., has completely redesigned its line of centrifugal air separators which are now available in nine sizes

Cutaway view of air separator

ranging from 18 in. to 18 ft. in diameter. In the improved machine, feed enters the separator through a hopper, descending to a rotating disk from which it is thrown toward the walls of the separating chamber. A fan placed above the disk produces a cyclone effect within the chamber, effecting stratification of the particles by weight. Heavy grains immediately drop out and are discharged while other particles may not be immediately removed unless they are light enough to be lifted by the suction of a second fan placed above the separating chamber. The selective action, therefore, depends on the proper relation between centrifugal force and lifting suction, factors which are under ready control by the operator. Additional separation results from the deflector action of the lower fan. It is claimed that precise separations of any mesh product from 50 to 600 may be obtained and that changes from one mesh to another are easily effected. Due to the winnowing imparted by the lower fan, tailings are said to be remarkably clean.

Industrial cabinet for controlled atmosphere

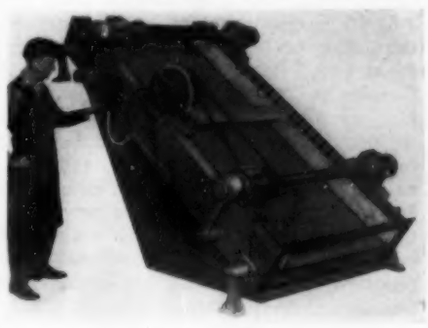
## Industrial Electric Oven

CONTROL of vapor pressure, humidity and temperature, at any desired values within a wide operating range, are features of a new temperature-control cabinet for experimental and plant work in drying, baking, evaporating and other operations, which is a development of the Freas Thermo-Electric Co., 1206 South Grove St., Irvington, N. J. The cabinets employ forced air circulation, are completely self-contained, and are available in a standardized series of sizes for maintaining dry and wet bulb temperatures in approximately the range from 5 deg. above room to 150 deg. F. Vapor pressures that can be maintained range from 0.5 to 4.5 in. of mercury above atmospheric pressure. Dehumidification and cooling apparatus will be supplied if desired.

## High-Capacity Screens

"QUADREX" is the name of a new line of vibrating screens recently announced by Stedman's Foundry & Machine Works, Aurora, Ind. High screen-

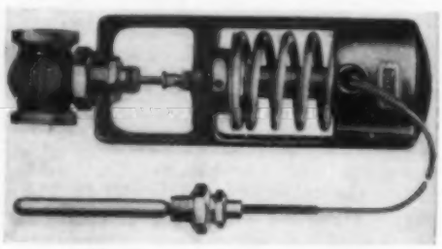
New "Quadrex" vibrating screen



ing efficiency, simplicity and rigidity of construction are said to be major features of this equipment. The screen deck is driven from its four corners through connecting rods operating on ball-bearing eccentrics. Through the use of stops above and below the screen, combined with play in the connecting rod sockets, the number of vibrations of the screen is increased to four times the rate of shaft revolution, giving 2,600 vibrations per minute with 650 r.p.m. at the shaft. The screen is provided with push-button control, dust-tight construction of driving parts and is built for ready maintenance. The two sizes offered are 4x6 ft. and 4x8 ft.

## Self-Acting Temperature Regulator

PRACTICAL elimination of friction, according to the manufacturers, is responsible for the high degree of accuracy and sensitivity claimed for the new Tycos self-acting temperature regulator, made by the Taylor Instrument Cos., Rochester, N. Y. It is stated that



Self-acting temperature regulator

the movements of the control valve follow temperature changes at the bulb so closely that true throttling control is obtained. The new controller is recommended for use in plating tanks, hot water circulating systems, drying rooms, and similar applications.

## Metal-Clad Insulating Panels

STRUCTURAL panels in sizes up to 4x12 ft., composed of rigid or semi-rigid insulating board, faced on one or both sides with steel or other metal sheets, have recently been announced by the Truscon Steel Co., Youngstown, Ohio. The new panels, known as "Ferroclad," are available for both low and high temperatures, in thicknesses depending on the core material, ranging from ½ to 3 in. A wide range of metal facings is available and the company has developed suitable adhesives for attaching the facings to the core material to suit numerous conditions. High insulation and sound reduction properties are said to be inherent in the new product. In a 1-in. panel using semi-rigid insulation, the over-all conductance is reported to be 0.25 B.t.u. per square foot per degree F. per hour.

# MANUFACTURERS' LATEST PUBLICATIONS

**Alloy Tubes.** Babcock & Wilcox Tube Co., Beaver Falls, Pa.—16-page bulletin on 4-6 per cent chromium steel tubes and pipe, giving corrosion, chemical and physical characteristics.

**Apparatus.** Bausch & Lomb Optical Co., Rochester, N. Y.—48 pages on instruments for spectrographic analysis.

**Blowers.** Roots-Connersville-Wilbraham, Connersville, Ind.—Publications as follows: 40-B10, Rotary displacement meters; 170-B10, Centrifugal blowers and compressors; 21-B21, Blowers for cleaning and drying barrels, etc.; 21-B22, Priming centrifugal pumps; 21-B23, Blowing units for specialized services.

**Burners.** Schutte & Koerting Co., Philadelphia, Pa.—Bulletin 16-A—16 pages on this company's mechanical oil burners.

**Chemicals.** J. T. Baker Chemical Co., Phillipsburg, N. J.—146-page June, 1932, catalog of laboratory and technical chemicals.

**Chemicals.** Columbia Alkali Corp., Empire State Building, New York City—Booklet listing and briefly describing available packages and uses of this company's line of products including alkalis, calcium chloride, whiting and salt.

**Coatings.** E. I. duPont de Nemours & Co., Wilmington, Del.—12-page folder concerning the uses of "S-D-O," the synthetic drying oil made by this company.

**Condensers.** National Radiator Corp., Johnstown, Pa.—Report CP-6—21-page engineering report with data and illustrations on this company's new line of condensing and cooling sections, listing results of comparative tests.

**Condensers.** Pennsylvania Pump & Compressor Co., Easton, Pa.—Bulletin 411—8 pages on the jet condensers and auxiliaries for vacuum processes manufactured by this company.

**Coolers.** Schutte & Koerting Co., Philadelphia, Pa.—Bulletin 12-D (Supplement 1)—4 pages on aftercoolers for compressed air.

**Cooling Equipment.** Niagara Blower Co., 6 East 45th St., New York City—Bulletins 33 and 34—Each 4 pages, respectively covering description and engineering data on fan coolers and brine spray coolers.

**Crushers.** Patterson Foundry & Machine Co., East Liverpool, Ohio.—8 pages on the "Gyro-Centric" crusher made by this company.

**Dust Handling.** American Air Filter Co., Louisville, Ky.—Form 270—8 pages illustrating and describing the "Turbo-Clone" combined blower and dust precipitator recently developed by this company.

**Equipment.** Alloy Pump & Valve Co., 6007 Euclid Ave., Cleveland, Ohio—Folder describing briefly this company's line of pumps, valves, fittings, and castings, all produced in a variety of metals and alloys.

**Equipment.** Bethlehem Foundry & Machine Co., Bethlehem, Pa.—New series of loose-leaf bulletins, covering this company's standard jacketed and unjacketed processing vessels, Thermocoil apparatus, accessories, materials of construction and Wedge-type roasters.

**Fans.** The Duriron Co., Dayton, Ohio—Bulletin 166—12 pages with engineering data concerning this company's acid-resisting exhaust fans.

**Grinding.** Hardinge Co., York, Pa.—Folder 276—Lists itemized grinding costs in several industries using Hardinge mills.

**Instruments.** American Meter Company, Erie, Pa.—Bulletin E-5—29-page handbook on the principles and application of this company's equipment for controlling flow of gases and liquids.

**Instruments.** Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh, Pa.—Leaflet describing this company's optical pyrometer for high temperature.

**Instruments.** Esterline-Angus Co., Indianapolis, Ind.—Catalog 732—78 pages completely describing a new line of graphic instruments made by this company for recording electrical quantities, pressures, time, liquid level, speed and other functions.

**Lacquers.** Hercules Powder Co., Wilmington, Del.—4-page discussion of the effect of resins and plasticizers on the moisture permeability of nitrocellulose lacquers.

**Lubrication.** Acheson Oildag Co., Port Huron, Mich.—4-page technical bulletin on the use of colloidal-graphited lubricants.

**Materials Handling.** Whiting Corp., Harvey, Ill.—Catalog 214—68 pages on this company's complete line of cranes for capacities ranging from 3 to 350 tons.

**Metal Protection.** Grasselli Chemical Co., Cleveland, Ohio—30 pages completely describing the use of "Cadalyte," this company's product and process for cadmium plating.

**Metal Protection.** Udylite Process Co., Detroit, Mich.—Booklet entitled "More Than a Pound," describing services to users of the company's cadmium-plating process.

**Motors.** Lincoln Electric Co., Cleveland, Ohio—4-page folder describing a stainless steel motor of fully inclosed construction.

**Motors.** Triumph Electric Corp., Cincinnati, Ohio—Table of motor characteristics for use in determining types of motors for various applications and for checking performance of old installations.

**Piping.** Sarco Co., 183 Madison Ave., New York City—Folder listing prices and describing the applications of Sarco "Pipe-Savers," metal inserts for protecting the threaded ends of pipe.

**Piping.** Taylor Forge & Pipe Works, P.O. Box 485, Chicago, Ill.—8-page booklet illustrating the use of this company's weld fittings and spiral welded pipe in the fabrication of pipe lines.

**Pumps.** Ingersoll-Rand Co., 11 Broadway, New York City—Folder illustrating and describing this company's now complete line of motorized pumps, available in sizes from 5 to 800 gal. per minute.

**Pumps.** Taber Pump Co., Buffalo, N. Y.—4-page folder describing this company's line of standard sump pumps.

**Refrigeration.** Ross Heater & Mfg. Co., Buffalo, N. Y.—Bulletin 325—8 pages on the characteristics of this company's flash-type refrigeration system for producing moderately low temperatures.

**Refrigeration.** York Ice Machinery Corp., York, Pa.—Bulletin 32164—16 pages on this company's booster compressors, recently developed for the attainment of low temperatures.

**Rubber.** B. F. Goodrich Rubber Co., Akron, Ohio—24 pages of engineering data on industrial rubber goods including belting, hose, packing, linings, etc.

**Screens.** Gifford-Wood Co., Hudson, N. Y.—Bulletin 123—12 pages of description, screen tests and other information on the Mitchell vibrating screen made by this company.

**Separators.** Dings Magnetic Separator Co., Milwaukee, Wis.—Bulletin describes this company's new high-intensity magnetic separator and discusses the separation of feebly magnetic substances.

**Separators.** Raymond Bros. Impact Pulverizer Co., 1515 N. Branch St., Chicago, Ill.—Leaflet describing a 30-in. mechanical air separator for small batches.

**Steam Lines.** Croll-Reynolds Engineering Co., 17 John St., New York City—Bulletin 40-A—8 pages on this company's "Flexo Disc" packingless expansion joint made of alloy steel.

**Tanks.** Littleford Bros., 447 East Pearl St., Cincinnati, Ohio—11 pages illustrating and describing the types of metal tanks which this company is prepared to fabricate.

**Temperature Control.** The Foxboro Co., Foxboro, Mass.—Bulletin 177—48 pages on temperature control, describing instruments, charts, valves, and auxiliaries.

**Thickeners.** Genter Thickener Co., 50 Broad St., New York City—Folder describing in detail the new Genter thickener described in the June, 1932, issue of *Chem. & Met.*

**Valves.** Ohio Injector Co., Wadsworth, Ohio—4-page chart giving a comparison of the valve figure numbers of various valve manufacturers.

**Wire Cloth.** Newark Wire Cloth Co., Newark, N. J.—Catalog 32—104 pages on this company's wide range of wire cloth for screens, sieves and filters.

**Welding.** Blaw-Knox Co., Pittsburgh, Pa.—Catalog 1397—22 pages, well illustrated, on the use of this company's welding process in the fabrication of carbon- and alloy steel vessels.

**Welding.** Hedges-Walsh-Weidner Co., Chattanooga, Tenn.—8-page reprint, Part 4, of an article on the development of welding for pressure vessels.

**Welding.** Metal & Thermit Corp., 120 Broadway, New York City—15 pages on the use of Murex coated electrodes in the welding of various steels and for various applications.

# NEWS OF THE INDUSTRY

**Petroleum industry to expand use of hydrogenation process. United Chromium patent upheld in chromium plating litigation. Nitrogen cartel may result from recent meeting of European and Chilean interests. European cartels in mercury and sulphur reach breaking point**

## Divisional Meetings To Feature A.C.S. Gathering

Symposia arranged by the different divisions of the American Chemical Society will have a prominent place in the eighty-fourth meeting of the society to be held at Denver, Colo., Aug. 22-26. Proceedings will open on Aug. 22 with a Council Meeting in the morning followed by a general meeting in the afternoon. The address of the president is scheduled for the evening of Aug. 24 at which time the Priestly medal will be presented to Charles L. Parsons and the society's award in pure chemistry to Oscar K. Rice.

Under the chairmanship of Dr. Cary R. Wagner of the Pure Oil Co., of Chicago, the Petroleum Division will hold a symposium on advances in petroleum research.

Two symposia, one on "Industrial Coatings Related to Paint and Varnish," and the other on "Primers and Protective Coatings for Special Metals," will feature the meetings of the Division of Paint and Varnish Chemistry. Harley A. Nelson, research chemist, New Jersey Zinc Company, Palmerton, Pa., is chairman of this Division.

The Division of Colloid Chemistry, headed by E. O. Kraemer, research chemist of the du Pont Co., Wilmington, Del., is sponsoring a symposium on "Flotation." Papers on flotation, energies of immersion, wettability, adsorption of powders, and related subjects, will be read.

Sessions of the Divisions of Water, Sewage and Sanitation Chemistry, A. S. Behrman, chief chemist, International Filter Company, Chicago, chairman, will deal especially with zeolite water-softening and the re-use of sewage waters in arid regions.

## Electrochemists Will Meet In Cleveland

With headquarters at the Hotel Cleveland, The Electrochemical Society, Inc., will hold its sixty-second meeting in Cleveland, Sept. 22-24. Charles H. Eldridge will preside at the opening session on "Electrodeposition." Papers on cadmium, zinc, and brass will be featured. Prof. Alexander Lowy will be chairman of a session on "Electro-Organic Chemistry." The Electronic Division will hold a meeting devoted to "Recent Developments in Vacuum Tubes and Photo-Electric Cells." Prof. Herman Schlundt will be in charge. Plant visits will include the Research Laboratories of the General Electric Co.; Goodyear Zeppelin Corp., National Carbon Co.; Harshaw Chemical Co.; and Westinghouse Electric & Manufacturing Co.

## Plans for Chemical Show Take Definite Form

THE Fourteenth Exposition of Chemical Industries will be held in New York during the week beginning February 27, 1933. Grand Central Palace will again be the location and three entire floors will be devoted to the exhibits showing the newest developments in raw materials, machinery, and manufactured products. Already more than 179 companies have reserved space. The exhibitors represent over forty American industries which are classified as chemical.

The Exposition of Chemical Industries, which is held every two years, provides an opportunity for studying the latest designs in a vast array of interesting equipment, and for comparing competitive products side by side. Special groupings of exhibits are being made such as 1. General Equipment—2. Chemicals and Chemical Products—3. Plastics, Molded Products, Lacquers, etc.—4. Laboratory Equipment and Supplies—5. Instruments of Precision—6. Containers and Packaging Section and Materials Handling Equipment—7. Raw Materials, Natural Resources and Industrial Opportunities, and 8. Educational Instructional Exhibits.

The Fourteenth Exposition promises to draw an unprecedented attendance, because of the timely value of the new products and processes which will be displayed. Exhibits of these new products developed by research will corroborate the findings of a survey conducted recently by the Division of Engineering and Industrial Research of the National Research Council. This survey was made to ascertain the present status of activities of leading industrial research laboratories. Returns from 350 companies show that one-half had invested more in research in 1931 than in 1929. According to the companies reporting, they now place major emphasis upon the development of new products.

## Monsanto Brings in Gas Well at Nitro

Drillings in the Monsanto Chemical Works plant at Nitro, West Virginia, have been successful in bringing in a natural gas well with an estimated capacity of 1,000,000 cubic feet a day. Arrangements are promptly being made to put this gas under the boilers of the plant. It will replace coal formerly burned and will displace the natural gas previously purchased for process use in the operating departments. In sinking the well large quantities of brine solution were struck at the depth of about 1000 feet. It is possible this brine will prove a valuable chemical raw material.

## United Chromium, Inc. Wins Plating Suit

On July 29, the United States Circuit Court of Appeals handed down an opinion sustaining the District Court for Connecticut in granting a claim of infringement of patent drawn by United Chromium, Inc., against the International Silver Co. United Chromium, Inc., is assignee of the patent on chromium plating granted to Dr. Colin G. Fink, professor of electrochemistry at Columbia University. Denial of infringement had been based primarily upon four prior uses; of the U. S. Bureau of Standards; of the Eastman Kodak Co.; of the Westinghouse Lamp Co. at Bloomfield, N. J.; of the same company at Pittsburgh. The court in its decision reviewed the progress in chromium plating made by the above mentioned companies and held that the invention of Dr. Fink rested in the composition of the bath which nobody before had described or known. Continuing, the decision stated, "It makes no difference that the specifications contained more, or did not repeat what was already known. They contained the pregnant facts, clearly, adequately; for the first time the art could turn out chromium plating with certainty."

## Hercules Centralizes Research Activities

Centralization of all divisions of experiment and research at its new Experiment Station, near Wilmington, is announced by Hercules Powder Co. through Harry E. Kaiser, the director of the Station. The Kenvil, N. J., branch of the Experiment Station will cease to function as a separate organization and its facilities will be taken over by the company's explosives department, under the jurisdiction of the adjacent Kenvil plant. R. S. Hancock, assistant director in charge of explosives research, will be transferred to the main laboratories near Wilmington. Executive offices of the Station will hereafter be at the Hercules home office in Wilmington. This completes the concentration of research activities at the new Hercules Experiment Station, which was completed and put in operation last year, on a 300-acre site about five miles west of Wilmington.

## Philadelphia Engineers Employment Service

The Philadelphia Technical Service Committee, by means of their Job Consultation Service, is peculiarly fitted to secure for the employer "The right man for the right job." An analysis of the applications already submitted indicates that the 900 registrants represent a cross-section of the various technical professions, wage and age groups. From among this wide range of activities represented, the committee feels sure they can meet the prospective employers' requirements. This group offers experience in 300 industries. The work of the committee is done by volunteer workers from among the unemployed engineers, who give of their time and effort without recompense. Thus, this aid to employer and employee is offered without charge to either party.

This committee has the cooperation of the Engineers' Club of Philadelphia, the local sections of 12 National Engineering Societies, and is associated with the State Employment Commission.

## Modernization Program Underway in Rochester

Celebrating its fiftieth year in business and as evidence of its confidence in the future of the process industries, the Pfaudler Co. has authorized a program of modernizing and expanding its plant at Rochester, New York. George F. Kroha, vice-president, states that this rebuilding is necessary because of the increasing demand for glass-lined units of extremely large capacity.

Up to the present time it has been impossible to fabricate any all-welded seamless equipment larger than 7,000 gal. but the largest of the new furnaces now being installed will accomodate units of 10,000 gal. capacity. This furnace, the largest of the sort in the world, is oil fired and of the muffle type. A specially designed charging machine will handle a tank weighing over 25,000 lb. Mechanical handling will also be improved by installation of new traveling cranes. Refinements in enameling application and metallurgical control are also features. During the rebuilding at Rochester, the Pfaudler Co. has concentrated production in its Elyria, Ohio, plant.

## Byproduct Sulphuric Acid Production in 1931

To supply the mineral industry promptly with data on byproduct sulphuric acid production and markets during the past year, the following information is furnished by the United States Bureau of Mines.

The output of by-product sulphuric acid at copper and zinc plants in 1931, in terms of 60° acid, amounted to 862,729 short tons, of which 436,111 tons was produced at copper plants and 426,618 tons at zinc plants. At zinc plants, 100,956 tons of sulphur was used to supplement the gases derived from the roasting of zinc blende, and 381,216 tons of sulphuric acid was produced.

## Oil Industry Controls Hydrogenation Patent

Announcement has been made that as a result of a recent special meeting of Hydro Patents Co., control of the oil hydrogenation process in this country has passed to that company. As the Hydro Patents Co. comprises the leading oil companies of this country, it is thus placed under industry control.

The Hydro Patents Co. was organized originally by the Standard Oil Co. of New Jersey, the controlling stockholder in Standard-I. G. Co. All oil refining companies of sufficient size to make them potential users of hydrogenation were then offered stock of Hydro Patents, and many of them accepted.

Members of the company include: Atlantic Refining Co., Barnsdall Corp., Continental Oil Co., Mid-Continent Petroleum Corp., Richfield Oil Co. of California, Shell Union Oil Corp., Consolidated Oil Corp., Skelly Oil Co., Socony-Vacuum Corp., Standard Oil of California, Standard Oil Co, Indiana, Standard Oil Co., Ohio, Standard Oil Development Co., Pure Oil Co. and Texas Co.

### Hydrogenation Plant Visited

On August 9 more than fifty representatives of newspapers, technical journals and societies inspected the hydrogenation plant of the Standard Oil Co. at Bayway, N. J. This was the first large public group to see the plant in operation. It is now producing a high grade motor oil which will soon be marketed under the name Essolube. For five months during the past year this plant was used to produce a special kerosene which was in heavy demand for domestic range burners. It has also made a hydrogenated safety fuel for use in aircraft and motor boats. The safety feature of this fuel is that under normal conditions it will not ignite as easily as gasoline.

Of special interest to the chemical industries is a line of hydrogenated solvents for use in paint, varnish, lacquer, soap and textile manufacture. These solvents have been found to be superior to other petroleum products since they possess characteristics more nearly resembling those of coal-tar distillates. In fact a substitute for benzol, which has higher anti-knock characteristics than pure iso-octane, has been made by the process and marketed abroad.

It is understood that all of these products can now be produced on a price basis at least equal to that of products made by the older methods. Recent photographs of the Baton Rouge, La., plant appeared in the July *Chem. & Met.* A number of views of the Bayway plant will appear in a subsequent number.

# NEWS FROM WASHINGTON

By PAUL WOOTON
*Washington Correspondent of Chem. & Met.*

EVIDENCE that the position taken by domestic synthetic producers will be a decisive factor in the negotiations for reestablishment of the nitrogen cartel can no longer be ignored. This is not construed in Washington as implying that the domestic concerns will formally participate in any agreement that may be reached but simply that their stake and that of various banking houses in the outcome is so large that they must protect their interests. At the same time, Chile and the European synthetic producers cannot act confidently without considering the reaction in the United States.

Reports from Europe prior to the meeting scheduled by the Chileans in New York were informative to the extent that they revealed that nothing had been finally settled. The conference at The Hague adjourned Aug. 3 with the report that the Europeans had reached an agreement among themselves but not with the Chileans. It had previously been reported that an agreement covering production, prices and export quotas was signed at London July 20 subject to the approval of the Chilean government. A few days later the despatches from London stated that the agreement related only to stabilization of world prices at a higher level. Then after jumping to Berlin the conferees were credited with having agreed on an export quota for Chile equivalent to 1,000,000 tons of nitrate of soda. Chile had demanded a quota of 2,000,000. The European nations proposed 800,000 tons. Chile came down to 1,200,000 and the report that 1,000,000 was agreed upon sounded plausible.

Chile's threat to dump its nitrate at ruinous prices is not regarded seriously because all the nitrate now held by Cosach in Europe and the United States is pledged to bankers and stocks in Chile can't very well be released unless Cosach is reimbursed by the Government at a proper figure.

The Chilean government's announcement that credit of 10,000,000 pesos would be granted for opening several of the independent oficinas is regarded as a political move. Previous promises have been made to the unemployed in the northern part of the country to the effect that Cosach would be dissolved in order to spread nitrate operations. Conditions attached to the granting of credit are reported to be so onerous that few of the independent producers are expected to respond. It appears that their output must be mortgaged to the government so that it cannot be sold without its consent.

### Greater Control Over Alcohol

The effect of the joint ruling of the Bureau of Prohibition and the Bureau of Industrial Alcohol requiring the shipment of completely denatured alcohol in drums only is to put an increasing proportion of the traffic in denatured alcohol under greater control and force users on to a permit basis. Already there is a marked shift from the completely denatured to the specially denatured formulas. Officials of the Bureau of Industrial Alcohol argue that S. D. No. 1 is entirely satisfactory and as cheap or cheaper than any of the c. d. formulas for chemical and solvent uses. They believe that users should not object to taking out a permit for s. d. formulas and making the "simple" monthly reports also required.

Whether Roy W. Chapin's selection as Secretary of Commerce is an effort to placate the tax-ridden automobile manufacturers or a gracious overture to the electorate of Michigan as a whole, Mr. Lamont's retirement from the cabinet to become the president of the American Iron & Steel Institute is of significant importance to several industries. It may signify that the steel industry is going in for adequate sales promotion. To structural materials such as lumber, brick and cement this may augur a heavy competitive seige but, on the other hand, more steel framing may create a wider market for processed insulating materials of many descriptions. Mr. Lamont doesn't attract publicity but he works quietly, effectively and he is the Institute's first full-time president. Another noteworthy angle on Mr. Lamont's debut is the statement by Charles M. Schwab that maintenance of the price structure is one of the principal problems to be solved.

### Interpretation of Excise Taxes

The Bureau of Internal Revenue still is struggling with nice questions of definition and usage raised by the imposition of the new excise taxes. Industrial benzol has been exempted from the tax of 1c. a gallon. Thanks to the effective intervention of Warren N. Watson, secretary of the Manufacturing Chemists Association, the chemical industry will save $200,000 a year, as 20,000,000 to 25,000,000 gallons of benzol is consumed in semi-refined and refined form in chemical and solvent processes.

Lubricating oils that have been exempted from the tax of 4c. a gallon when used for other purposes include road oil, cordage oil, agricultural spray oil, cotton softener oil, ink oil, medicinal white oil, and oil used as a component material in the manufacture of non-taxable oils, paint, insecticides, soap stock, grease, etc. Oleaginous substances are classed as grease and not subject to the tax only if (1) of a worked consistency of less than 390 penetration units or an unworked consistency of less than 360 penetration units and (2) free from oil or comprising oil and a soap or a mixture of soaps or of soaps and other substances. Technical naphtha of certain specifications used in the production of naval stores also has been ruled tax-free.

The Manufacturing Chemists Association is printing and distributing a warning label for use on drums filled with hydrofluoric acid, mixed acid, sulphuric acid, ammonia, lacquers, solvents and other products which are subject to internal pressure and otherwise set up hazards unless properly handled. The price quoted for the labels is $2.75 per M in lots of 500 to 1,000, $1.85 in lots of 5,000 to 10,000; and $1.15 in lots of 50,000 up.

### Valuation for Tariff Duties

There are many schemes for taking the kinks out of levying tariff duties. Most of them would use as a basis some form of valuation ascertainable within this country. Even now the Tariff Commission, in response to congressional direction, is studying the extent to which value in the United States may properly be used.

But foreign (invoice) value probably will remain the basis on which duties on most imports are assessed. The chances are that in the process of shifting to another basis, the tariff wall would be raised. This is what protectionists have in the back of their heads, although there are many valid arguments discrediting the present system. Customs officials don't relish the prospect of a change. Any other basis than the invoice price is bound to be more complicated.

Alternative methods now apply to some extent but in general, they present an arithmetical hodge-podge that is little better than the prevailing practice, which assumes that importers are essentially honest and that fluctuations in foreign value which affect the dollar-pulling power of the tariff even out in the long run.

The effort made in the revision leading up to the 1930 tariff to levy duties on the domestic basis petered out in a $250,000 demonstration by the Tariff Commission that it is not practical.

# NEWS FROM ABROAD

*By Special Correspondents of Chem. & Met. at London, Berlin and Paris*

## London

IT IS very difficult to form any opinion of the trend of chemical industry and markets generally, because the picture is so blurred by international, political and financial events and prospects. Against the success of the War Loan Conversion operation and the probability of something tangible at Ottawa, must be balanced the difficult situation in Germany and Ireland, and the continued clogging of the machinery of international trade. It is therefore pleasant to record that some progress has been made in dealing with the international nitrogen situation at the discussions held in Paris, and probably it is only a question of time before the process of bargaining with Chile gives definite shape to a revised nucleus, upon which one can hope to build.

In the rayon field, Courtaulds Ltd. still set the pace and make it difficult for others to survive, but probably the end of the year will mark the end of these repressive measures. Samuel Courtauld has on the last two or three occasions in his address at the annual meeting of his company, complained of the unnecessary duplication of plants and of the price cutting which would be inevitable if others continued to poach on his preserves. There is therefore a touch of irony in his latest address, in which he announced the entry and continued expansion of Courtaulds into the transparent paper or cellophane market, and their intention to expand until they were in a position to supply the whole of the requirements of this country.

The Cellulose Acetate Silk Company which has been in existence for two years, appears to have turned the corner and to be making a profit, with an expanding demand for their yarn, so that the situation in the acetate rayon field, though of minor importance, may become particularly interesting.

The annual meeting of the Society of Chemical Industry was very successful, and Professor Morgan's presidential address, referring as it did to the unnecessary duplication of societies and institutions, gave much food for thought. He showed that in analyzing the expenditure of certain representative organizations, the members have to spend 55 per cent of their subscription on administration and general office expenses, 32 per cent net for scientific literature, and 13 per cent for meetings, social and library expenses; this seemed definitely a reflection upon our chemical "Civil Service," especially when it is realized how much of the time and energy of the members of councils and committees is given free of charge.

Sir William Pope, proved a worthy Messel medalist, and the visit to Messrs. Boots new factory, which is a palace of steel and glass, made a great impression. Messrs. Boots incidentally are now making soap.

Considerable development was reported at the annual meeting of Palestine Potash, Ltd., operating in the Dead Sea. The bromine plant has been working for a year and is being extended from its present capacity to 2 tons per day. Deliveries of crude and purified potash salt have been made and a new pipe line, 30 in. in diameter has been laid at the bottom of the Dead Sea to reach a depth of 175 feet where the brine has its maximum density and potash and bromine content.

Transport and marketing facilities have also been satisfactorily developed, and next year's report should be ready at a time when a clearer picture can be formed of the ultimate possibilities.

Particulars are now available of the new Tungum alloy exhibited at the Conversazione of the Institution of Civil Engineers last month. This is a nickel copper silicon alloy, which displays high resistance to acid corrosion, while its physical characteristics bring it into line with those of mild steel. It can be brazed, welded, soldered, spun, machined and tempered and drawn into wire to make gauze as fine as 200 mesh. It is stated to be resistant to hydrochloric acid and weak sulphuric acid, as well as to sea water and acetic acid, and apparently this material shows considerable promise, provided the sponsors pay adequate attention to research and technical requirements.

The death of Sir Richard Threlfall, and of the Hon. J. W. Wilson, has robbed Messrs. Albright & Wilson, Ltd., of Oldbury, the well-known specialists in phosphorus compounds, of their two principal directors.

The General Electric Company, Ltd., has for some time been carrying on research and experiments with a new kind of lamp, known as the Hot Cathode Lamp. This is stated to save 70 per cent of the current consumption as compared with the present standard lamp, and it is hoped that it will lend itself to street lighting, and enable arterial roads to be sufficiently cheaply illuminated to avoid the necessity of automobiles having to use their headlights when speeding at night.

## Berlin

THE Institute for Economic Research has studied the causes for unemployment, which is particularly severe in Germany; of 33,000,000 possible workers about a fifth were jobless in February, 1932. Technology does play a part, it was found: Comparing 1930 with 1926, mechanical productivity increased by about 25 per cent, in the mining industry by about 18, in the iron industry by about 15, and in the chemical industry about 13 per cent. On the whole it was found that a 10 per cent higher production volume in 1930 was accomplished with fewer total labor hours than in 1926.

The report of the I. G. Farbenindustrie on the second quarter reflected some of the fears expressed earlier. While business in dyes is comparatively satisfactory, pharmaceutical and photographic chemicals have suffered from outside barriers. Rayon has fallen off for the same reason while domestic consumption of fertilizer continued to recede. However, this is partly balanced by increase in export, so that stocks are being reduced, and production was slightly increased. Meanwhile there is no change in the position of synthetic gasoline, while the anticipated domestic petroleum production has not made progress.

The Mansfeld Copper Company, which has been showing considerable losses for the past few years in spite of government aid, is to be taken into federal control. Since a domestic source of production is a national necessity, it will be easier for the state to carry the cost of technical improvements toward lowering production costs, and meanwhile to use the copper in its own operations, the railroad, and the post; the byproduct silver would go into coinage. The only alternative is to give the company further financial support.

The Gesellschaft für Kohlentechnik, Dortmund, has completed work on its process for sulphur removal from wet gas. The purpose is to eliminate the impure iron-bearing sulphur and to combine the ammonia extraction from coke gases with sulphur removal. The ammonia is thereby obtained not only as sulphate but also as mixed fertilizer. The experiments for removing carbon monoxide from industrial and blast furnace gases, are also completed. The cyanogen content of coke gases is being

converted into guanidine preparations and sold at a profit.

A really unbreakable glass has been brought into commerce by the Glaswerken Bicheroux & Company, Herzogenrath, which, without the use of reinforcement, is supposed to be much more resistant to impact, pressure and vibration than normal or laminated glass. A 500 gr. steel ball can be dropped on this glass from a height of 2½ m. and will rebound without leaving a mark. The elasticity of the glass is so great that a braced sheet will support two men, whereby the glass is bent like a razor blade and then, after removal of the weight, returns to its original position. This glass, which is called "Sekurit," has half the strength of steel and twice the elasticity. It is not sensitive to temperature or atmospheric influences; since it has no lamination, the danger of bubble formation or darkening is eliminated. Of course, this glass is wholly transparent and does not change with age. Of particular interest is the fact that, when fractured by a sufficiently strong blow, it does not shatter into long splinters but crumbles up into granular pieces which have no sharp edges.

The Siemens-Schuckert Werke, who are working with tantalum, have found that under certain circumstances, this will serve as a cathode material for electrolytic separation of copper, zinc, nickel, cobalt, silver, gold and cadmium, but not tin.

## Paris

BECAUSE the standing of different companies engaged in rayon manufacture is now known, it is possible to report on the industry as a whole. In general the older companies, despite reductions in business, have been able to continue their dividends. On the other hand, newer plants making viscose, nitrate, and acetate, have not only dropped their dividends, but have also incurred large losses, such as 15,000,000 Fr. by the Tubize, 8,000,000 by Textiles Chimiques du Nord et de l'Est, while La Soie de Compiégne has lost almost its whole capital.

It cannot be said that the industry faces disaster; for while the last year and a half has been very poor, there has been some recovery and most plants are fully occupied. Because the prices have dropped so far, only the old amortized plants are still able to show a margin. Meanwhile the Bureau of Artificial Textiles, whose purpose is distribution of rayon and standardization of selling practices, has achieved an accord between French viscose producers. Each plant has its production prorated according to its capacity and according to the outside market. This only concerns domestic business and not foreign markets.

A similar agreement has been concluded between five Belgian viscose producers who have created a holding company, the Fabelta, with a capital of 130,000,000 Fr., and have placed at its disposal all their production and sales facilities, their patents and technical agreements, as well as their stock. Since a representative of the Industrie Française de la Soie Viscose is on the board of this new company, it looks like the beginning of a Franco-Belgian agreement on the eve of a virtually completed accord with German producers. It was the latter who formed an international viscose syndicate with a distribution committee which apportioned the exports of the Italian, Dutch, and Swiss producers, Germany itself still being in part an importer.

## Polish Producers Join European Dye Cartel

Three leading Polish coal-tar producers have signed a convention with the European dye cartel affecting the sale of dyes in Poland, according to a report from trade commissioner Gilbert Redfern, Warsaw. It was indicated that the accord outlines a uniform credit and price maintenance policy.

The Polish accession is another step in the development of the marketing agreement initiated in 1927 when negotiations were concluded between the German I.G. and French producers. In 1929, Swiss interests were brought into the cartel through a supplementary convention. Italy became a party to the pact in 1931 through acquisition of a controlling interest in the Italian dye industry by two members of the triple entente. The British Imperial Chemicals Industries, Ltd., constituted the next signatory of the extended Franco-German pact of 1927. Polish accession, therefore, marks the entrance to a sixth predominant national group into the continental cartel. Poland has a well developed coal tar chemical industry. Production of dyes averages around 3,000,000 pounds annually, which supplies a large percentage of domestic consumption.

## Dimethyl Sulphate Plant

Plant for the manufacture of dimethyl sulphate is now being erected at Belle, West Virginia, by the Ammonia Department, E. I. du Pont de Nemours & Co. The small-scale production which has led to the design of this plant indicates an exceptionally pure product which will be available on a large scale when the new unit is complete. Prices have not yet been announced.

## Sulphur Consortium in Sicily Dissolved

Dissolution of the Sicilian Sulphur Consortium as of July 31, is announced in reports to the Department of Commerce which state that about 200,000 tons of sulphur in stock is to be taken by the Bank of Sicily for liquidation over six years.

Reports indicate the Sicilian sulphur industry has been stimulated to produce without regard to market conditions, in order to obviate losing royalties accruing to owners of subsoil rights which are to be abolished by the Beluzzo law, on expiration of contracts. In addition the economic relations between the industry in Sicily proper and the Italian continental sulphur industry have been disturbed by the growth of the latter to an annual figure of 100,000 tons. On the continent sulphur refining and production being both centralized in the hands chiefly of one large chemical-metallurgical company may have an advantage over the Sicilian trade practices involving production and refining by separate interests.

The Sulphur Consortium has been in existence for about 12 years functioning primarily as a sulphur sales organization. In July, 1930, its control was changed from governmental supervision to control by sulphur operators.

## National Power Show Will Be Held in December

The Tenth National Exposition of Power and Mechanical Engineering will be held at the Grand Central Palace, New York, December 5-10. Two years have elapsed since the last exposition and in the interim many lines have been completely revamped and research has been responsible for many new designs and devices to meet the demands of changed economic conditions. The exposition will offer the first opportunity to show these to engineers collectively and to explain the improvements. The inclusive nature of exhibits may be inferred from the fact that at latest reports 305 companies already had contracted for space at the exhibition.

## Carbon-Carburant Congress Will Meet in Milan

The second International Carbon-Carburant Congress will meet at the Italian Touring Club, Milan, Italy, October 1-7. The Congress has for its scope the study and discussion of questions of a scientific, technical, economic, industrial and commercial nature with regard to production and utilization of carbon.

# NAMES IN THE NEWS

F. E. HAMER, editor of *The Chemical Age*, London, ever since its inception, has resigned from that position because of the unsatisfactory condition of his health after a year of intermittent illness. His successor is A. C. CROSS.

G. E. SAVOY, formerly of the Swenson Evaporator Company and the University of Michigan, has now joined the firm of T. F. Crahan, New York.

SIDNEY T. ARMSBY, who was erroneously mentioned in the last issue of *Chem. & Met.* as service director of the Haden Lime Company, resigned from that company early this year and became engaged in consulting chemical engineering at Houston, Tex.

J. C. WHETZEL, who has been connected with the American Sheet & Tin Plate Company since 1920, and since 1922 as manager of the research laboratory, has now been appointed assistant to the vice-president.

E. S. TAYLORSON, since 1924 engineer of tests for the American Sheet & Tin Plate Company and since 1922 assistant director of research, has been appointed manager of the research laboratory.

CHARLES H. MARSHALL, until recently a member of the technical staff of the Bell Telephone Laboratory, Inc., has joined the firm of Lucius Pitkin, Inc., consulting chemists and metallurgists, as materials engineer.

WILLIAM FORD, has resigned as the chairman of the board of directors of the Owens-Illinois Glass Co., but will remain as member of the board.

GEORGE F. STROHAVER, for the past seven years dean of chemistry at Holy Cross College, has joined the faculty of Georgetown University as head of the chemistry department. He was active in the Worcester Chemists Club, for a time as president, the only organization of its kind outside of New York City.

W. T. DOHERTY, for ten years engaged in chemical engineering work for the Humble Oil & Refining Co., has been made head of the Gulf Coast division of petroleum engineering for that company. Mr. Doherty, a native of Houston, Texas, graduated from Texas A. & M. College in chemical engineering.

G. V. CORLESS, who was head of the Gulf Coast division of petroleum engineering for the Humble Oil and Refining Co., has been made division superintendent there.

HARRY A. CURTIS, director of research of the Vacuum Oil Co., has been named by the council of the American Institute of Chemical Engineers as chairman of the committee on chemical

engineering education. He succeeds H. C. Parmelee, chairman for nearly ten years past, who retires because of the press of other duties.

WILLIAM R. HUEY is now located at Swarthmore, Pa., engaged in consulting work on corrosion and materials of construction. In the course of his prior ten years with the duPont company's staff he became its metallurgical and corrosion engineer.

## OBITUARY

ROBERT S. PERRY, former president of the Kalbfleisch Corp. and active in paint technology, died at his home in Cave Springs, Ga., on July 13, at the age of 67. Born in Bristol, R. I., Mr. Perry studied chemistry and metallurgy at Lehigh University and Freiberg, Germany. In 1902, as chemical engineering expert in paint and varnish, he became president of Harrison Bros. & Co., and remained there until he joined the Kalbfleisch Corp. in 1916. He has been in retirement for the past few years.

VAN H. MANNING, early experimenter on helium and director of the U. S. Bureau of Mines during the War, died at his home at Forest Hills, N. Y. on July 13 at the age of 70. A native of Mississippi, where he received his schooling, he joined the Bureau of Mines as assistant director in 1910 and became director in 1915. He not only recruited chemical engineers for war problems, but afterwards concentrated his energies on helium in Texas, where his efforts brought the cost down to a remarkably low figure. In 1920 he was appointed director of research for the American Petroleum Institute.

IRWIN G. PRIEST, color authority for the U. S. Bureau of Standards, died at his home in Washington on July 19 at the age of 46. As chief of colorimetric work, he had developed standards in nomenclature, measurements, and specifications.

PHILIP HAYNES, for 32 years connected with the Solvay Process Company, and chief engineer of its plant at Tully, N. Y., died on July 14 at the age of 53.

WILLIAM J. ROBERTSON, president of the Heller & Merz Corp., died suddenly in New York on July 21 in his 60th year. In his connection with his firm, for over 37 years, he constantly grew in authority until this March, when the company was an affiliate of the Calco Chemical Company, he was promoted to the presidency.

R. C. SCHUPPHAUS, authority on nitrocellulose and pyroxylin, died at his home in Brooklyn, N. Y., on July 26, at the age of 69. To him is attributed the first satisfactory domestic smokeless powder furnished to the United States government. For years he was associated with Hudson Maxim and his pyrotechnic inventions. Late in life he took up the study of law and became a member of the bar in 1926.

## CALENDAR

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, annual meeting, Washington, D. C., Dec. 7-9.

FOURTEENTH EXPOSITION OF CHEMICAL INDUSTRIES, New York, week of Feb. 27, 1933.

AMERICAN CHEMICAL SOCIETY, 84th meeting, Denver, Colo., Aug. 22-26.

AMERICAN GAS ASSOCIATION, annual convention, Atlantic City, N. J., Oct. 4-6.

AMERICAN PETROLEUM INSTITUTE, 13th annual meeting, Houston, Tex., Nov. 15-17.

ELECTROCHEMICAL SOCIETY, fall meeting, Cleveland, Sept. 22-24.

NATIONAL METAL EXPOSITION AND CONGRESS, Buffalo, N. Y., Oct. 3-8.

NATIONAL SAFETY COUNCIL, 21st annual Safety Congress, Washington, D. C., Oct. 3-7.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, fall meeting, Holyoke, Mass., Sept. 14-16.

# Agreement Among International Producers Of Nitrogen Draws Nearer

ACCORDING to advices from abroad, long-continued negotiations between European and Chilean producers of nitrogen have made satisfactory progress which at a later meeting may terminate in a definite agreement. At different times meetings have been held in Paris, London, and Berlin. At the London meeting in July an agreement was reported to have been reached which would regulate production, export quotas, and prices of nitrogen products. This agreement was subject to the approval of the Chilean government. Representatives of producers in eleven European countries and Chile participated in the negotiations.

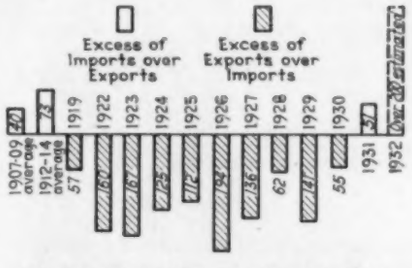
An agreement reached earlier in July among European producers of sulphate of ammonia covered production, exports and price control. It was reported that a major obstacle to the formation of a European-Chilean agreement was the European opposition to an export quota for Chile of 1,200,000 tons of nitrate of soda and the Chilean demand for a quota of 60 per cent of the French nitrate market. The preliminary agreement led to an increase in the price of sulphate of ammonia and withdrawal by some foreign producers of offers for future delivery to export markets.

Meeting at Scheveningen at the beginning of August, these nitrogen interests were reported to have smoothed out the difficulties which still remained. The outcome of the meeting lacks official corroboration but unofficial reports say that a document embodying the terms of agreement arrived at, is now in preparation and will be ratified at a subsequent meeting.

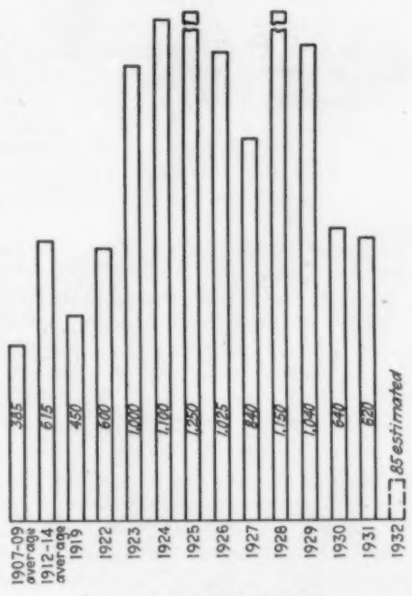
Developments in foreign producing fields naturally directs closer scrutiny upon the domestic nitrogen industry. With the fertilizer trade offering the largest consuming outlet for the principal nitrogen-bearing materials, the accompanying graphs will prove of interest in pointing out the relative importance which different materials have held in the fertilizer industry in recent years.

Preliminary compilations place domestic sales of fertilizer in 1931 at 6,339,501 tons which is considerably under the totals for the two preceding years. Naturally this was reflected in a reduced use of raw materials with the disproportionate decline in some materials accentuating the growing importance of ammonia nitrogen.

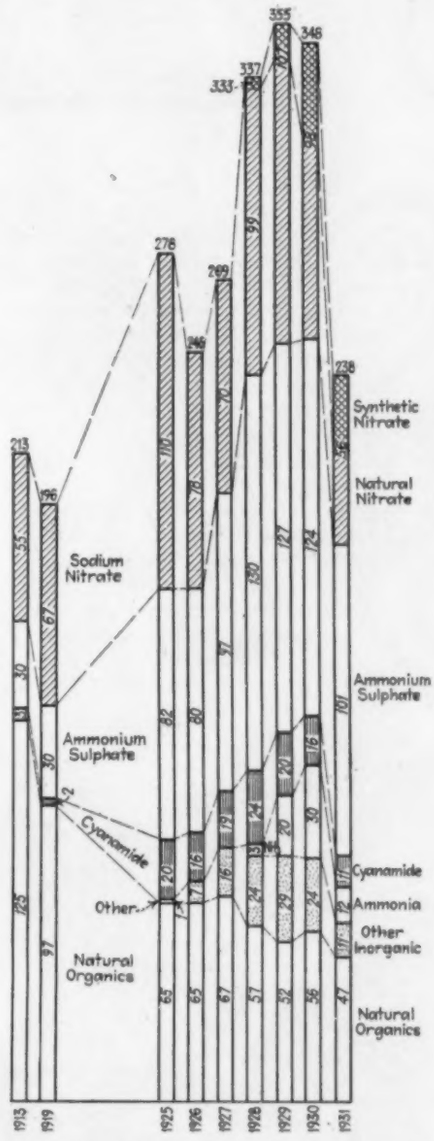
The establishment of synthetic production of nitrate of soda in this country would, in the natural course, tend to reduce importations of the natural product from Chile. The large drop in fertilizer production and consumption in the present year also would work against a normal volume of nitrate shipments to this country. These factors of themselves, however, would not account for the fact that official figures place nitrate imports for the first half of 1932 at 44,954 tons in comparison with 365,965 tons for the comparable period of 1931. In the absence of definite statistics it is not possible to state what part of natural nitrate has been replaced by the synthetic product. Large stocks of Chilean nitrate held in this country also may have had much to do with restricting importations, but according to reports there has been no large reduction in accumulations here and competition from other materials appears to be working against consumption of nitrate.




**Foreign Trade in Ammonium Sulphate**
**Thousands of Short Tons**




**Imports of Sodium Nitrate**
**Thousands of Short Tons**




**Nitrogen in Fertilizer Used in United States, Thousands of Short Tons of Contained N**

**Chemical Nitrogen Used as Fertilizer**
(In Terms of Short Tons of Nitrogen)

| | 1919 | 1925 | 1926 | 1927 | 1928 | 1929 | 1930 | 1931 |
|---|---|---|---|---|---|---|---|---|
| Nitrate of soda | 67,000 | 110,000 | 78,000 | 70,000 | 99,000 | 107,000 | 98,500 | 56,375 |
| Sulphate of ammonia | 30,000 | 82,000 | 80,000 | 97,000 | 130,000 | 127,400 | 124,000 | 101,000 |
| Calcium cyanamide | 2,000 | 20,000 | 16,000 | 19,000 | 24,000 | 20,400 | 15,750 | 11,000 |
| Ammonia | ..... | ..... | ..... | ..... | 3,000 | 20,000 | 30,000 | 12,000 |
| Calcium nitrate | ..... | 1,360 | 2,360 | 3,200 | 4,000 | 5,300 | 5,640 | 1,500 |
| Ammonium sulphate-nitrate | ..... | ..... | 4,540 | 12,500 | 19,000 | 9,400 | 2,400 | 650 |
| Urea and calurea | ..... | ..... | ..... | ..... | 400 | 7,100 | 6,340 | 2,760 |
| Ammonium phosphate (includes nitrophoska) | ..... | ..... | ..... | ..... | 600 | 6,900 | 9,230 | 6,150 |
| Total chemical | 99,000 | 213,360 | 180,900 | 201,700 | 280,000 | 303,500 | 291,860 | 191,435 |

# CHEMICAL ECONOMICS

**Sharp decline in rate of activities in chemical-producing centers in July. Reports indicate reduced manufacturing operations in all sections of the country and in all chemical branches**

SLOWER call for chemicals and related products was generally reported for July and this condition had a direct influence upon the rate of manufacturing operations. According to reports compiled by *Electrical World* practically all branches of the chemical industry slowed down operations during the month. The index number for chemical production in July, based on consumption of electrical energy, was 109.1, which compares with 115.7 for the preceding month.

Reports which have come to hand recently announce a speeding up in production since the turn of the month with a large number of employees recalled in different industries, some of which had previously been operating on a greatly reduced scale.

The accompanying table gives definite comparisons of production and consumption in some of the industries for June and the preceding month.

| | 1932 | |
|---|---|---|
| **Production** | **June** | **May** |
| Arsenic, crude, ton | 1,060 | 1,133 |
| Arsenic, refined, ton | 841 | 1,059 |
| Alcohol, ethyl, 1,000 pr. gal. | 10,500 | 11,578 |
| Alcohol withdrawn for denaturation 1,000 pr. gal. | 8,900 | 8,244 |
| Automobiles, No. | 183,092 | 184,284 |
| Byproduct coke, 1,000 tons | 1,537 | 1,743 |
| Cottonseed oil, crude, 1,000 lb. | 39,689 | 67,670 |
| Cottonseed oil, ref., 1,000 lb. | 70,470 | 89,717 |
| Glass containers, 1,000 gr. | 1,945 | 2,027 |
| Glass, plate, 1,000 sq.ft. | 4,910 | 3,016 |
| Methanol, crude, gal. | 161,978 | 251,011 |
| Methanol, ref., gal. | 97,154 | 72,267 |
| Methanol, syn., gal. | 712,637 | 742,826 |
| Pine oil, gal. | 189,752 | 201,628 |
| Rosin gum, receipts, bbl. | 96,115 | 91,527 |
| Rosin wood, bbl. | 29,483 | 30,597 |
| Turpentine, gum, receipts, bbl. | 26,841 | 27,410 |
| Turpentine, wood, bbl. | 4,827 | 5,151 |
| Sulphuric acid produced in fertilizer trade, ton | 45,039 | 50,690 |
| **Consumption** | | |
| Cotton, 1,000 bales | 321 | 332 |
| Silk, bales | 37,466 | 32,923 |
| Fertiliser in south, 1,000 tons | 68 | 156 |
| Rubber, tons | 35,987 | 26,861 |
| Sulphuric acid in making fertiliser, ton | 29,824 | 30,256 |

According to census returns, the factory production of fats and oils (exclusive of refined oils and derivatives) during the three-month period ended June 30, 1932, was as follows: vegetable oils, 403,438,850 lb.; fish oils, 5,938,158 lb.; animal fats, 553,147,389 lb.; and greases, 80,923,082 lb.; a total of 1,043,447,479 lb. Of the several kinds of fats and oils covered by this inquiry, the largest production, 408,690,771 lb., appears for lard. Next in order is cottonseed with 224,152,123 lb.; tallow with 142,260,759 lb.; linseed oil with 65,763,572 lb.; coconut oil with 62,357,667 lb.; corn oil with 24,320,418 lb.; soybean oil with 9,256,762 lb.; and castor oil with 8,939,195 lb.

Foreign trade in chemicals shows no indications of a change for the better. On a basis of valuation exports of chemicals and related products are lower by more than 32 per cent for the first half of this year than for the first half of 1931. The difference in unit values would reduce the comparison somewhat on a tonnage comparison. The fact remains, however, that export trade for the year to date has declined sharply both in volume and in value. Despite the general decline in outward shipments, gains were recorded for calcium arsenate, boric and hydrochloric acids, methanol, butanol, acetone, carbon tetrachloride, carbon bisulphide, citrate of lime, bleaching powder, and calcium chloride. Exports of sodium compounds for the six-month period were 215,851,218 lb. in 1932 and 256,160,039 lb. in 1931. Bichromate and borate surpassed the 1931 totals but sharp losses were reported for salt cake, niter cake, caustic soda, and soda ash. Ammonium sulphate likewise lost materially in export trade.

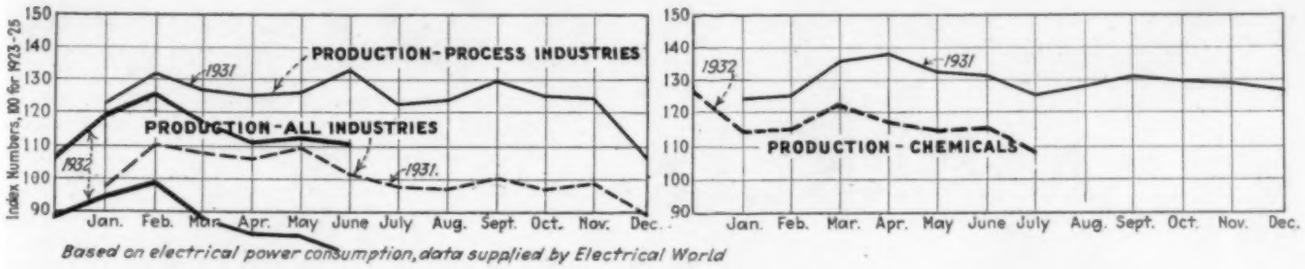
Import trade in chemicals for the first half of this year declined even more sharply than export trade. On a value basis the drop for the present year was approximately 44.5 per cent. The decline was fairly uniform throughout the different groups. Exceptions to the general rule were found in the case of copper sulphate, magnesium compounds, nitrate of potash, and lithopone and zinc pigments.

In the fertilizer group ammonium sulphate stands out. Imports this year in June alone almost equalled the total for the entire year of 1931. Comparisons for the six-month periods show a total of 165,441 tons for the present year and 33,911 tons for 1931.

### By-Products Obtained from Coke-Oven Operations in 1931 *a*

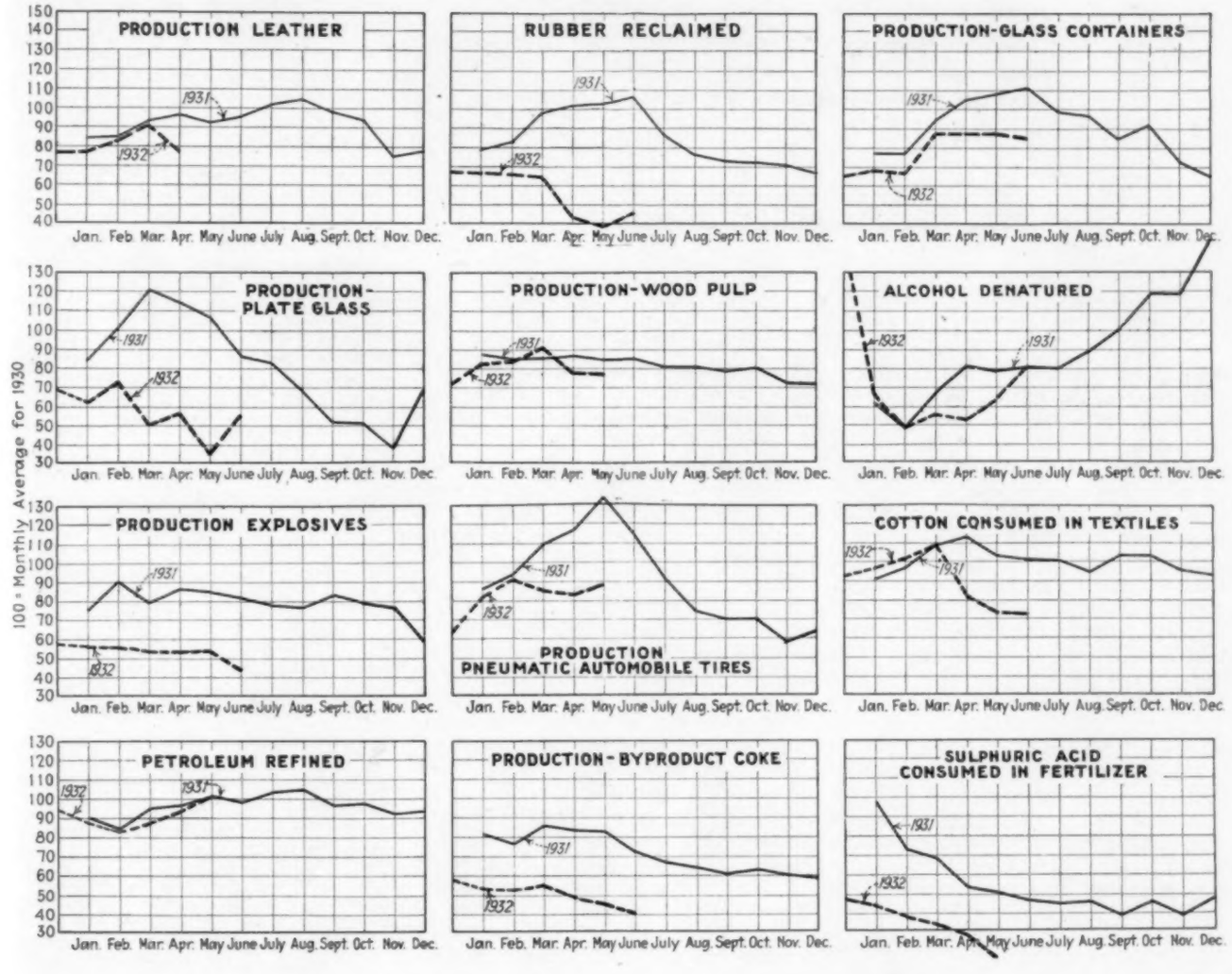
| Product | Unit | Production | Sales |
|---|---|---|---|
| Tar | gal. | 450,856,092 | 273,164,573 |
| Ammonia: | | | |
| Sulphate | lb. | 983,614,651 | 1,007,561,803 |
| Ammonia liquor ($NH_3$ content) | lb. | 39,089,088 | 37,347,144 |
| Sulphate equivalent of all forms | lb. | 1,135,971,003 | 1,156,950,379 |
| Light oil and derivatives: | | | |
| Crude light oil | gal. | *c*122,529,148 | 8,739,202 |
| Benzol, crude and refined | gal. | 14,772,297 | 14,267,081 |
| Motor benzol | gal. | 61,960,025 | 61,471,006 |
| Toluol, crude and refined | gal. | 11,832,932 | 12,693,294 |
| Solvent naptha | gal. | 3,772,025 | 3,463,950 |
| Xylol | gal. | 2,028,729 | 2,074,126 |
| Other light oil products | gal. | 4,163,028 | 2,007,860 |
| | | *d*98,529,036 | 104,716,519 |
| Naphthalene, crude and refined | lb. | 7,622,929 | 7,360,309 |
| Tar derivatives: | | | |
| Creosote oil, distillate as such | gal. | 13,740,196 | 13,686,594 |
| Creosote oil in coal-tar solution | gal. | 2,551,402 | 2,141,073 |
| Pitch of tar | tons | 78,983 | 4,951 |
| Other tar derivatives | ... | ..... | ..... |
| Phenol | gal. | 94,097 | 110,352 |
| Other products *e* | ... | ..... | ..... |
| Value of all by-products sold | ... | ..... | ..... |

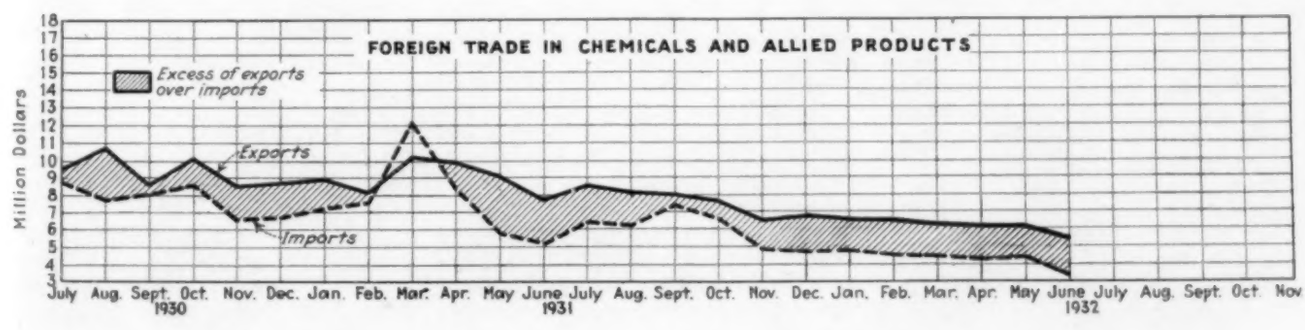
(*a*) Includes products of tar distillation conducted by coke-oven operators under same corporate name, excepting, however, phenol, and other tar acids produced at Clairton, Pennsylvania. (*b*) Includes gas wasted and gas used for heating retorts. (*c*) Refined on the premises to make the derived products shown, 117,625,416 gallons. (*d*) Total gallons of derived products. (*e*) Carbolate, crude products, cyanogen, sodium prussiate and sulphur. (*f*) Exclusive of the value of breeze production, which in 1931 amounted to $6,637,976.




*Based on electrical power consumption, data supplied by Electrical World*

# TRENDS OF PRODUCTION AND CONSUMPTION





FOREIGN TRADE IN CHEMICALS AND ALLIED PRODUCTS
Excess of exports over imports
Exports
Imports
Million Dollars
July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov
1930
1931
1932

# MARKETS

**Foreign developments furnished main high lights in market for chemicals in the last month including progress toward formation of nitrogen cartel, dissolution of Sicilian sulphur consortium, collapse of mercury cartel, and negotiations for trade pact between Canada and the United Kingdom.**

WHILE the market for chemicals received no rush of buying orders in recent weeks, the outlook has brightened materially and improvement in consuming demand is anticipated in view of the widespread reports of increased activities in many industries which are large consumers of chemicals.

Formation by New York banks of the Commodities Corporation with capital that may reach $100,000,000 added to the feeling of optimism. This corporation will make loans to consumers of raw materials to finance purchases of stocks for manufacturing purposes.

Principal developments of the month, however, were found in reports received from foreign markets. Because of its broad scope, the recent meeting of European and Chilean interests to form an international nitrogen cartel came first in importance. The effect of price and export control upon domestic markets can be determined only when the policy of the cartel—if it comes into existence—becomes known.

Negotiations which have been underway at Ottawa in recent weeks have for their purpose the formation of closer trade relationship between the United Kingdom and the Colonies. Reduction in the volume of chemicals imported into Canada from the United States is said to be included among the objectives. Closed meetings have been in order so that definite information has not been available and even the Canadian press has been furnished with but meagre details of the conference. Unofficial advices have stated that the British plan proposed that Canada reduce chemical importations from the United States by 10 per cent and make up this reduction by imports from Great Britain.

The progress of the conference is said to have fallen far short of expectations and press accounts credit Canada with making demands which are not acceptable to England.

#### Dissolution of Sulphur Consortium

Announcement that the Italian government had decided to terminate the Sicilian Compulsory Sulphur Consortium and to abrogate the agreement effective between the consortium and American producers was the culmination of unsatisfactory conditions which had arisen in the Italian industry. The plan of liquidating stocks covers a six-year period. This would not indicate any immediate sales pressure but the opening of foreign markets to competitive influences is by no means conducive to price stability. The fact that the Italian government will appropriate four million lire a year for six years is an indication that plans for liquidation recognize the probability of lower prices.

#### Mercury Sales Cartel Collapses

Although the Italian-Spanish cartel for the control of sales of mercury has not been officially dissolved, it has in effect ceased to function since Italian producers have expressed their intention to withdraw from the agreement which was to continue until 1934. Attempts to hold prices in face of increased outputs in other countries have not only restricted sales but resulted in stock accumulations. The rate of duty on imports of mercury offers some protection to domestic producers but new lows may be established in foreign markets which will place them on an export parity.

#### Alcohol Ruling Meets Objections

Considerable dissatisfaction has been expressed with Treasury Decision No. 9 which, in effect, provides that completely denatured alcohol must be packaged in single-trip drums, each bearing a non-defaceable serial number. This precludes the movement of this grade of alcohol by tank car outside of the control and ownership of the producer. In defense of the ruling it is advanced that the greater part of completely denatured alcohol production has been for anti-freeze use. For such use it is handled in drums before it reaches the retailer. Extra cost in handling in drums of single-trip type is held to be negligible. In cases where completely denatured alcohol is used in industry a choice is offered of buying it in drums or of changing to the use of specially denatured alcohol. Already a pronounced switch to SDA-1 is reported. Protests on the ground that drums owned by consumers will have no value under the new ruling have been met with the argument that this will be but temporary idleness until diversion to other uses for the drums can be accomplished.

On Aug. 10 the Department of Agriculture issued a report on the present flax crop as of Aug. 1. The estimated yield is given at 15,800,000 bu. The July report estimated total yield at 18,200,000 bu.

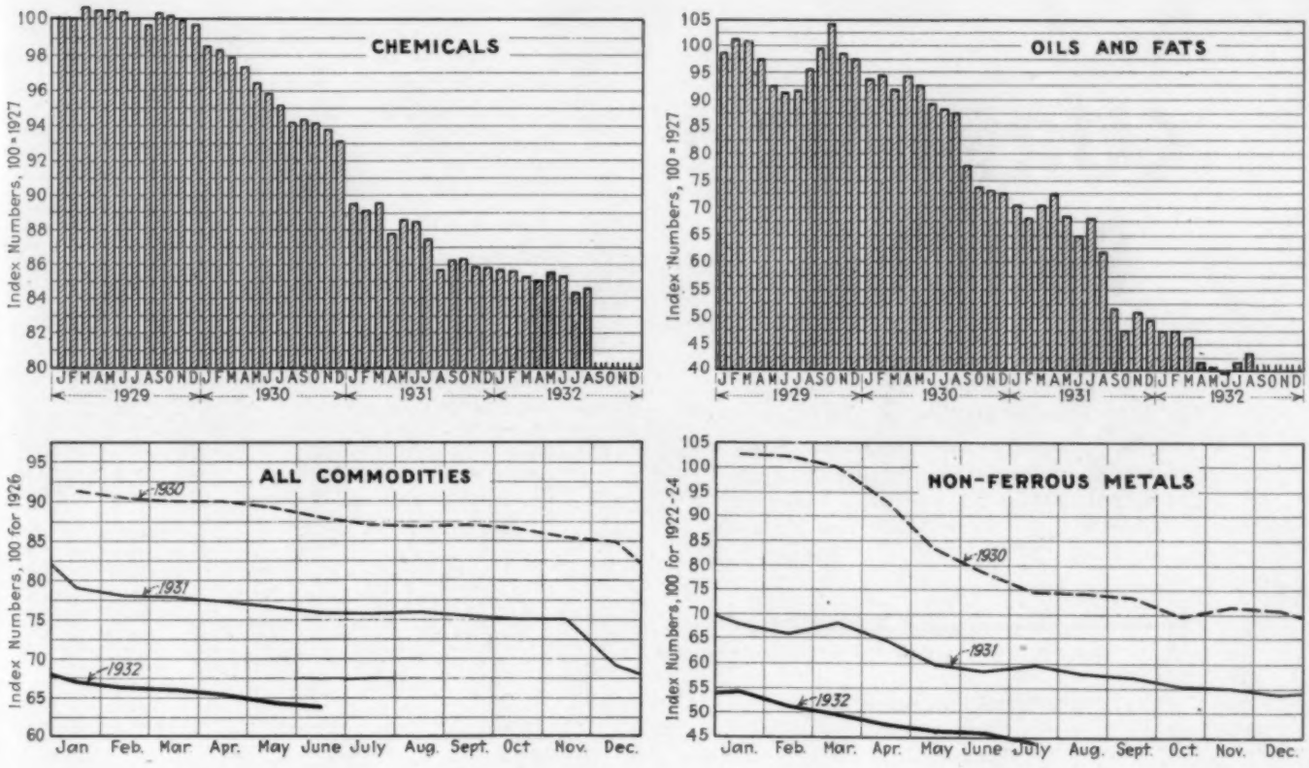
## Acid and Alkalis Used in Petroleum Refining

The total value of the sulphuric acid, caustic soda and soda ash consumed in the petroleum refining industry as reported in the 1929 Census was approximately $46,600,000. This included the tonnages for the respective products shown below:

| | Sulphuric acid | Caustic soda (tons 2,000 lbs) | Soda ash |
|---|---|---|---|
| 1919..... | 522,060 | 22,635 | (1) |
| 1927..... | 1,216,743 | 95,026 | 21,221 |
| 1929..... | 1,483,863 | 134,054 | 18,441 |

(1) No data.

About one-third, 476,273 tons of the sulphuric acid used in 1929 was the reclaimed product while the balance of 1,007,590 tons was new acid. There was an increase of nearly six fold from 1919 to 1929 in caustic soda consumed in this industry. Texas, California and Pennsylvania had the largest consumption of these chemicals.


CHEMICALS
Index Numbers, 100 = 1927
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1929
1930
1931
1932
OILS AND FATS
Index Numbers, 100 = 1927
ALL COMMODITIES
Index Numbers, 100 for 1926
1930
1931
1932
Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec
NON-FERROUS METALS
Index Numbers, 100 for 1922-24

# PRICE TRENDS—CHEM. & MET.'S WEIGHTED INDEXES

PRICE changes were not numerous in the last month and the steady position of most chemicals gave further evidence that values had been thoroughly adjusted. Reports of increased activities in different consuming industries gave a firmer tone to the market but buying was reported to have been confined largely to current needs. Trade sentiment, however, has been of a more encouraging nature. The outlook for the near future is generally regarded as brighter than had been anticipated a month ago. With a larger volume of chemicals passing to consumers, the price level will be more easily controlled and it is possible that some offerings will appreciate in price but many basic chemicals will not be affected except that a generally firmer market over the remainder of the year may work as a guarantee against any lowering in contract prices which will be named for deliveries over next year.

Future values for nitrogen-bearing materials appear to be more dependent upon regulatory provisions to be adopted by producers in different countries than upon the ordinary laws of supply and demand. At the close of the period, foreign sulphate of ammonia was not offered freely for shipment to this country and no new developments had arisen in the Chilean nitrate situation. A clearer conception of future competition will be possible when and if the international nitrogen cartel becomes operative.

Metals appear to have reached a more stable position which indicates a steadier price for the salts. Pig lead, in particular, is regarded as well established and firm or higher prices for the oxides are forecast. White lead is offered with a guarantee against price declines over the remainder of the year.

Vegetable oils and animal fats show a decidedly upward price trend with a better buying movement following the rise in values. Tallow which was a drug on the market while it was quoted below 2c. a pound has been sold in large volume since the increase in price. More logical reason for belief in a still higher price level for vegetable oils was found in the estimate on the size of the cotton crop as made public on August 8. Reduced acreage, curtailed use of fertilizer, and heavy weevil damage made certain that the yield would fall below that of last year and the official estimate places the decline in excess of 5,000,000 bales. In consequence, the outlook for a relatively strong market for cottonseed oil is warranted and most of the vegetable oils follow the leadership of cottonseed oil.

Linseed oil closed in a firmer position but arrivals of new crop seed should hold price advances to very moderate limits.

### Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

| | |
|---|---|
| **This month** | **84.53** |
| Last month | 84.33 |
| August, 1931 | 85.77 |
| August, 1930 | 94.15 |

Offerings of sulphate of ammonia for shipment from abroad were reserved and domestic goods were held at advanced prices. Lead oxides followed the upward price swing of the metal. Naval stores were lower but showed signs of recovery late in the period.

### Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1927

| | |
|---|---|
| **This month** | **43.41** |
| Last month | 41.95 |
| August, 1931 | 61.53 |
| August, 1930 | 87.36 |

Crushers offered linseed oil at lower levels but the majority of other vegetable oils were firm with an upward trend of values. Animal fats improved during the month and give impetus to the rise in the weighted index number.

# CURRENT PRICES

**The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Aug. 11.**

## Industrial Chemicals

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Acetone, drums, lb. | $0.10 -$0.11 | $0.10 -$0.11 | $0.10 -$0.11 |
| Acid, acetic, 28%, bbl., cwt. | 2.65 - 2.90 | 2.65 - 2.90 | 2.60 - 2.85 |
| Glacial 99%, tanks | 8.89 - | 8.89 - | 8.98 - |
| drs. | 9.14 - 9.39 | 9.14 - 9.39 | 9.23 - 9.48 |
| U. S. P. reagent, c'bys. | 9.64 - 9.89 | 9.64 - 9.89 | 9.73 - 9.98 |
| Boric, bbl., lb. | .04½- .05 | .04½- .05 | .06½- .07 |
| Citric, kegs, lb. | .30 - .31 | .30 - .31 | .35 - .36 |
| Formic, bbl., lb. | .10 - .11 | .10 - .11 | .10 - .11 |
| Gallic, tech., bbl., lb. | .50 - .55 | .50 - .55 | .50 - .55 |
| Hydrofluoric 30% carb., lb. | .06 - .07 | .06 - .07 | .06 - .07 |
| Latic, 44%, tech., light, bbl., lb. | .11½- .12 | .11½- .12 | .11½- .12 |
| 22%, tech., light, bbl., lb. | .05½- .06 | .05½- .06 | .05½- .06 |
| Muriatic, 18° tanks, cwt. | 1.00 - 1.10 | 1.00 - 1.10 | 1.00 - 1.10 |
| Nitric, 36°, carboys, lb. | .05 - .05½ | .05 - .05½ | .05 - .05½ |
| Oleum, tanks, wks., ton. | 18.50 -20.00 | 18.50 - | 18.50 -20.00 |
| Oxalic, crystals, bbl., lb. | .11 - .11½ | .11 - .11½ | .11 - .12 |
| Phosphoric, tech., c'bys., lb. | .08½- .09 | .08½- .09 | .08½- .09 |
| Sulphuric, 60°, tanks, ton. | 11.00 -11.50 | 11.00 -11.50 | 11.00 -11.50 |
| Sulphuric, 66°, tanks, ton. | 15.50 - | 15.50 - | 15.50 - |
| Tannic, tech., bbl., lb. | .23 - .35 | .23 - .35 | .23 - .35 |
| Tartaric, powd., bbl., lb. | .23 - .24 | .23 - .24 | .30½- .33 |
| Tungstic, bbl., lb. | 1.40 - 1.50 | 1.40 - 1.50 | 1.40 - 1.50 |
| Alcohol, ethyl, 190 p'f., bbl., gal. | 2.53½- | 2.53½- | 2.33 - |
| Alcohol, Butyl, tanks, lb. | .113 - | .113- | .15½- |
| Alcohol, Amyl | - | - | - |
| From Pentane, tanks, lb. | .182- | .182- | .203 |
| Denatured, 188 proof | | | |
| No. 1 special dr., gal. | .34½- | .34½- | .28 - |
| No. 5, 188 proof, dr., gal. | .38½- | .38½- | .28 - |
| Alum, ammonia, lump, bbl., lb. | .03 - .04 | .03 - .04 | .03½- .04 |
| Chrome, bbl., lb. | .04½- .05 | .04½- .05 | .04½- .05 |
| Potash, lump, bbl., lb. | .03 - .04 | .03 - .04 | .03½- .04 |
| Aluminum sulphate, com., bags, cwt. | 1.25 - 1.40 | 1.25 - 1.40 | 1.25 - 1.40 |
| Iron free, bg., cwt. | 1.90 - 2.00 | 1.90 - 2.00 | 1.90 - 2.00 |
| Aqua ammonia, 26°, drums, lb. | .02½- .03 | .02½- .03 | .02½- .03 |
| tanks, lb. | .02½- .02½ | .02½- .02½ | .02½- .02½ |
| Ammonia, anhydrous, cyl., lb. | .15½- .15½ | .15½- .15½ | .15½- .15½ |
| tanks, lb. | .05½- | .05½- | .05½- |
| Ammonium carbonate, powd. tech., casks, lb. | .10 - .11 | .10 - .11 | .10½- .11 |
| Sulphate, wks., cwt. | 1.00 - | .90 - | 1.75 - |
| Amylacetate tech., tanks, lb., gal. | .16 - | .16 - | .172 |
| Antimony Oxide, bbl., lb. | .06½- .08 | .06½- .08 | .08 - .09 |
| Arsenic, white, powd., bbl., lb. | .04 - .04½ | .04 - .04½ | .04 - .04½ |
| Red, powd., kegs, lb. | .09 - .10 | .09 - .10 | .09 - .10 |
| Barium carbonate, bbl., ton. | 56.50 -58.00 | 56.50 -58.00 | 56.50 -58.00 |
| Chloride, bbl., ton. | 63.00 -65.00 | 63.00 -65.00 | 63.00 -65.00 |
| Nitrate, cask, lb. | .07 - .07½ | .07 - .07½ | .07 - .07½ |
| Blanc fixe, dry, bbl., lb. | .03½- .04 | .03½- .04 | .03½- .04 |
| Bleaching powder, f.o.b., wks., drums, cwt. | 1.75 - 2.00 | 1.75 - 2.00 | 2.00 - 2.10 |
| Borax, grain, bags, ton. | 40.00 -45.00 | 40.00 -45.00 | 50.00 -57.00 |
| Bromine, cs., lb. | .36 - .38 | .36 - .38 | .36 - .38 |
| Calcium acetate, bags | 2.50 - | 2.50 - | 2.00 - |
| Arsenate, dr., lb. | .05½- .06½ | .05½- .06½ | .06 - .07 |
| Carbide drums, lb. | .05 - .06 | .05 - .06 | .05 - .06 |
| Chloride, fused, dr., wks., ton. | 18.00 - | 18.00 - | 20.00 - |
| flake, dr., wks., ton. | 21.00 - | 21.00 - | 22.75 - |
| Phosphate, bbl., lb | .08 - .08½ | .08 - .08½ | .08 - .08½ |
| Carbon bisulphide, drums, lb. | .05 - .06 | .05 - .06 | .05 - .06 |
| Tetrachloride drums, lb. | .06½- .07 | .06½- .07 | .06½- .07 |
| Chlorine, liquid, tanks, wks., lb. | .01½- | .01½- | .01½- |
| Cylinders | .04 - .06 | .04 - .06 | .04 - .06 |
| Cobalt oxide, cans, lb. | 1.25 - 1.35 | 1.25 - 1.35 | 1.35 - 1.45 |
| Copperas, bgs., f.o.b. wks., ton. | 13.00 -14.00 | 13.00 -14.00 | 13.00 -14.00 |
| Copper carbonate, bbl., lb. | .07 - .16 | .07 - .16 | .08½- .18 |
| Cyanide, tech., bbl., lb. | .39 - .44 | .39 - .44 | .41 - .46 |
| Sulphate, bbl., cwt. | 2.75 - 2.90 | 2.75 - 2.90 | 3.70 - 4.00 |
| Cream of tartar, bbl., lb. | .17 - .17½ | .17½- .18 | .22½- .23 |
| Diethylene glycol, dr., lb. | .14 - .16 | .14 - .16 | .14 - .16 |
| Epsom salt, dom., tech., bbl., cwt. | 1.70 - 2.00 | 1.70 - 2.00 | 1.70 - 2.00 |
| Imp., tech., bags, cwt. | 1.15 - 1.25 | 1.15 - 1.25 | 1.15 - 1.25 |
| Ethyl acetate, drums, lb. | .10 - | .10 - | .07 - |
| Formaldehyde, 40%, bbl., lb. | .06 - .07 | .06 - .07 | .06 - .07 |
| Furfural, dr., contract, lb | .10 - .17½ | .10 - .17½ | .10 - .17½ |
| Fusel oil, crude, drums, gal | 1.10 - 1.20 | 1.10 - 1.20 | 1.10 - 1.20 |
| Refined, dr., gal. | 1.80 - 1.90 | 1.80 - 1.90 | 1.80 - 1.90 |
| Glaubers salt, bags, cwt. | 1.00 - 1.10 | 1.00 - 1.10 | 1.00 - 1.10 |
| Glycerine, c.p., drums, extra, lb | .10½- .10½ | .10½- .11 | .11½- .12 |
| Lead: | | | |
| White, basic carbonate, dry casks, lb. | .06½- | .06½- | .07½- |
| White, basic sulphate, sck., lb. | 06 - | .06 - | .07 - |
| Red, dry, sck., lb. | .06½- | .06½- | .07½- |
| Lead acetate, white crys., bbl. lb. | .10 - .11 | .10 - .11 | .10 - .11 |
| Lead arsenate, powd., bbl., lb. | .09½- .14 | .09½- .14 | .10 - .14 |
| Lime, chem., bulk, ton. | 8.50 - | 8.50 - | 8.50 - |
| Litharge, pwd., csk, lb. | .05½- | .05½- | .06½- |
| Lithophone, bags, lb. | .04½- .05 | .04½- .05 | .04½- .05 |
| Magnesium carb., tech., bags, lb. | .05½- .06 | .05½- .06 | .06 - .06½ |
| Methanol, 95%, tanks, gal. | .33 - | .33 - | .33 - |
| 97%, tanks, gal. | .34 - | .34 - | .34 - |
| Synthetic, tanks, gal. | .35½- | .35½- | .37½- |
| Nickel salt, double, bbl., lb. | .10½- .11 | .10½- .11 | .10½- .11 |
| Orange mineral, csk., lb. | .09 - | .09 - | .09½- |
| Phosphorus, red, cases, lb. | .42 - .44 | .42 - .44 | .42 - .44 |
| Yellow, cases, lb. | .28 - .32 | .31 - .32 | .31 - .32 |
| Potassium bichromate, casks, lb. | .08 - .08½ | .08 - .08½ | .09 - .09½ |
| Carbonate, 80-85%, calc. csk., lb | .05 - .05½ | .05 - .05½ | .05½- .06 |
| Chlorate, powd., lb. | .08 - .08½ | .08 - .08½ | .08 - .08½ |
| Hydroxide (c'stic potash) dr., lb. | .06½- .06½ | .06½- .06½ | .06½- .06½ |
| Muriate, 80% bgs., ton | 37.15 - | 37.15 - | 37.15 - |
| Nitrate, bbl., lb. | .05½- .06 | .05½- .06 | .05½- .06 |
| Permanganate, drums, lb. | .16 - .16½ | .16 - .16½ | .16 - .16½ |
| Prussiate, yellow, casks, lb. | .18½- .19½ | .18½- .19 | .18½- .19 |
| Sal ammoniac, white, casks, lb. | .04½- .05 | .04½- .05 | .04½- .05 |
| Salsoda, bbl., cwt. | .90 - .95 | .90 - .95 | .90 - .95 |
| Salt cake, bulk, ton. | 13.00 -15.00 | 13.00 -15.00 | 16.00 -18.00 |
| Soda ash, light, 58%, bags, contract, cwt. | 1.15 - | 1.15 - | 1.15 - |
| Dense, bags, cwt. | 1.17½- | 1.17½- | 1.17½- |
| Soda, caustic, 76%, solid, drums, contract, cwt. | 2.50 - 2.75 | 2.50 - 2.75 | 2.50 - 2.75 |
| Acetate, works, bbl., lb. | .05 - .06 | .05 - .06 | .05 - .05½ |
| Bicarbonate, bbl., cwt. | 1.85 - 2.00 | 1.85 - 2.00 | 1.85 - 2.00 |
| Bichromate, casks, lb. | .05 - .06 | .05 - .06 | .07 - .07½ |
| Bisulphate, bulk, ton. | 14.00 -16.00 | 14.00 -16.00 | 14.00 -16.00 |
| Bisulphite, bbl., lb. | .03½- .04 | .03½- .04 | .03½- .04 |
| Chlorate, kegs, lb. | .05½- .07½ | .05½- .07½ | .05½- .07½ |
| Chloride, tech., ton. | 12.00 -14.75 | 12.00 -14.75 | 12.00 -14.00 |
| Cyanide, cases, dom., lb. | .15½- .16 | .15½- .16 | .16½- .17 |
| Fluoride, bbl., lb. | .07½- .08 | .07½- .08 | .07½- .08 |
| Hyposulphite, bbl., lb. | 2.40 - 2.50 | 2.40 - 2.50 | 2.40 - 2.50 |
| Nitrate, bags, cwt. | 1.77 - | 1.77 - | 2.05 - |
| Nitrite, casks, lb. | .07½- .08 | .07½- .08 | .07½- .08 |
| Phosphate, dibasic, bbl., lb. | 2.55 - 2.75 | 2.55 - 2.75 | .0265 - .03 |
| Prussiate, yel. drums, lb. | .11½- .12 | .11½- .12 | .11½- .12 |
| Silicate (30° drums), cwt. | .60 - .70 | .60 - .70 | .60 - .70 |
| Sulphide, fused, 60-62%, dr., lb. | .02½- .03½ | .02½- .03 | .02½- .03 |
| Sulphite, cyrs., bbl., lb. | .03 - .03½ | .03 - .03½ | .03 - .03½ |
| Sulphur, crude at mine, bulk, ton | 18.00 - | 18.00 - | 18.00 - |
| Chloride, dr., lb. | .03½- .04 | .03½- .04 | .05 - .06 |
| Dioxide, cyl., lb. | .06½- .07 | .06½- .07 | .06½- .07 |
| Flour, bag, cwt. | 1.55 - 3.00 | 1.55 - 3.00 | 1.55 - 3.00 |
| Tin bichloride, bbl., lb. | nom.- | nom.- | nom.- |
| Oxide, bbl., lb. | .25½- | .25½- | .27 - .28 |
| Crystals, bbl., lb. | .23 - | .22 - | .25 - |
| Zinc chloride, gran., bbl., lb. | .06½- .06½ | .06½- .06½ | .06½- .06½ |
| Carbonate, bbl., lb. | .10½- .11 | .10½- .11 | .10½- .11 |
| Cyanide, dr., lb. | .38 - .42 | .41 - .42 | .41 - .42 |
| Dust, bbl., lb. | .04½- .06 | .04½- .05 | .05½- .06 |
| Zinc oxide, lead free, bag, lb. | .05½- | .05½- | .06½- |
| 5% lead sulphate, bags, lb. | .05½- | .05½- | .06½- |
| Sulphate, bbl., cwt. | 3.00 - 3.25 | 3.00 - 3.25 | 3.00 - 3.25 |

## Oils and Fats

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Castor oil, No. 3, bbl., lb. | $0.09½-$0.10½ | $0.09½-$0.10 | $0.10½-$0.11 |
| Chinawood oil, bbl., lb. | .05½- | .05½- | .07 - |
| Coconut oil, Ceylon, tanks, N. Y. lb. | .03½- | .03½- | .04½- |
| Corn oil crude, tanks, (f.o.b. mill), lb | .03½- | .03 - | .06½- |
| Cottonseed oil, crude (f o.b. mill), tanks, lb. | .03½- | .03½- | .05½- |
| Linseed oil, raw car lots, bbl., lb. | .053- | .058- | .085- |
| Palm, Lagos, casks, lb. | .03½- | .03½- | nom. |
| Niger, casks, lb. | .03 - | .03½- | nom. |
| Palm kernel, bbl., lb. | .04½- | .04½- | .05 - |
| Peanut oil, crude, tanks (mill), lb. | .03½- | .03½- | .07 - |
| Rapeseed oil, refined, bbl., gal. | .31 - .32 | .29 - .30 | .45 - .47 |
| Soya bean, tank (f.o.b. Coast), lb. | nom.- | nom.- | nom.- |
| Sulphur (olive foots), bbl., lb. | .04½- | .04½- | .04½- |
| Cod, Newfoundland, bbl., gal. | .25 - .26 | .21 - .22 | .40 - .44 |
| Menhaden, light pressed, bbl., gal. | .30 - .32 | .30 - .32 | .34 - .36 |
| Crude, tanks (f.o b. factory), gal. | .12 - | .11½- .12 | .17½- |
| Grease, yellow, loose, lb. | .02½- | .01½- | .02½- |
| Oleo stearine, lb. | .05½- | .04½- | .07½- |
| Red oil, distilled, d.p. bbl., lb. | .06½- | .06½- | .07½- |
| Tallow, extra, loose, lb. | .02½- | .02½- | .03½- |

## Coal-Tar Products

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Alpha-naphthol, crude, bbl., lb. | $0.60 –$0.65 | $0.60 –$0.65 | $0.60 –$0.62 |
| Refined, bbl., lb. | .80 – .85 | .80 – .85 | .80 – .85 |
| Alpha-naphthylamine, bbl., lb. | .32 – .34 | .32 – .34 | .32 – .34 |
| Aniline oil, drums, extra, lb. | .14½– .15 | .14½– .15 | .15 – .16 |
| Aniline salts, bbl., lb. | .24 – .25 | .24 – .25 | .24 – .52 |
| Benzaldehyde, U.S.P., dr., lb. | $1.10 –$1.25 | $1.10 –$1.25 | $1.10 –$1.25 |
| Benzidine base, bbl., lb. | .65 – .67 | .65 – .67 | .65 – .67 |
| Benzoic acid, U.S.P., kgs, lb. | .48 – .52 | .48 – .52 | .57 – .60 |
| Benzyl chloride, tech., dr., lb. | .30 – .35 | .30 – .35 | .30 – .35 |
| Benzol, 90%, tanks, works, gal. | .20 – .21 | .20 – .21 | .20 – .21 |
| Beta-naphthol, tech., drums, lb. | .22 – .24 | .22 – .24 | .22 – .24 |
| Cresol, U. S. P., dr., lb. | .10½– .11 | .10½– .11 | .14 – .17 |
| Cresylic acid, 97%, dr., wks., gal. | .49 – .52 | .49 – .52 | .54 – .58 |
| Diethylaniline, dr., lb. | .55 – .58 | .55 – .58 | .55 – .58 |
| Dinitrophenol, bbl., lb. | .29 – .30 | .29 – .30 | .29 – .30 |
| Dinitrotoluen, bbl. lb. | .16 – .17 | .16 – .17 | .16 – .17 |
| Dip oil 25% dr., gal. | .23 – .25 | .23 – .25 | .26 – .28 |
| Diphenylamine, bbl., lb. | .38 – .40 | .38 – .40 | .38 – .40 |
| H-acid, bbl., lb. | .65 – .70 | .65 – .70 | .65 – .70 |
| Naphthalene, flake, bbl., lb. | .03½– .04¼ | .03½– .04¼ | .03½– .04¼ |
| Nitrobenzene, dr., lb. | .08½– .09 | .08½– .09 | .08½– .10 |
| Para-nitraniline, bbl., lb. | .51 – .55 | .51 – .55 | .51 – .55 |
| Para-nitrotoluine, bbl., lb. | .26 – .28 | .26 – .28 | .29 – .31 |
| Phenol, U.S.P., drums, lb. | .14½– .15 | .14½– .15 | .14½– .15 |
| Picric acid, bbl., lb. | .30 – .40 | .30 – .40 | .30 – .40 |
| Pyridine, dr., lb. | 1.50 – 1.75 | 1.50 – 1.80 | 1.50 – 1.80 |
| R-salt, bbl., lb. | .40 – .44 | .40 – .44 | .40 – .44 |
| Resorcinal, tech., kegs, lb. | .65 – .70 | .65 – .70 | 1.15 – 1.25 |
| Salicylic acid, tech., bbl., lb. | .33 – .35 | .33 – .35 | .33 – .35 |
| Solvent naphtha, w.w., tanks, gal. | .26 – | .26 – | .25 – .30 |
| Tolidine, bbl., lb. | .86 – .88 | .86 – .88 | .86 – .88 |
| Toluene, tanks, works, gal. | .30 – | .30 – | .30 – |
| Xylene, com., tanks, gal. | .26 – | .26 – | .25 – .28 |

## Miscellaneous

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Barytes, grd., white, bbl., ton. | $22.00–$25.00 | $22.00–$25.00 | $23.00–$25.00 |
| Casein, tech., bbl., lb. | .0⅝ – .10½ | .06 – .10½ | .06 – .11 |
| China clay, dom., f.o.b. mine, ton | 8.00 –20.00 | 8.00 –20.00 | 8.00 –20.00 |
| Dry colors: | | | |
| Carbon gas, black (wks.), lb. | .02½– .20 | .02½– .20 | .03 – .20 |
| Prussian blue, bbl., lb. | .35 – .36 | .35 – .36 | .35 – .36 |
| Ultramine blue, bbl., lb. | .06 – .32 | .06 – .32 | .06 – .32 |
| Chrome green, bbl., lb. | .26 – .27 | .27 – .28 | .27 – .30 |
| Carmine red, tins, lb. | 3.90 – 4.50 | 5.25 – 5.40 | 5.00 – 5.40 |
| Para toner, lb. | .75 – .80 | .75 – .80 | .77 – .80 |
| Vermilion, English, bbl., lb. | 1.25 – 1.50 | 1.35 – 1.50 | 1.55 – 1.60 |
| Chrome yellow, C. P., bbl., lb. | .16 – .16½ | .16 – .16½ | .16½– .17 |
| Feldspar, No. 1 (f.o.b. N.C.), ton | 6.50 – 7.50 | 6.50 – 7.50 | 6.50 – 7.50 |
| Graphite, Ceylon, lump, bbl., lb. | .07 – .08½ | .07 – .08½ | .07 – .08½ |
| Gum copal Congo, bags, lb. | .06 – .08 | .06 – .08 | .07 – .09 |
| Manila, bags, lb. | .16 – .17 | .16 – .17 | .16 – .17 |
| Damar, Batavia, cases, lb. | .16 – .16½ | .16 – .19 | .16 – .16½ |
| Kauri No. 1 cases, lb. | .45 – .48 | .45 – .48 | .48 – .53 |
| Kieselguhr (f.o.b. N.Y.), ton. | 50.00 –55.00 | 50.00 –55.00 | 50.00 –55.00 |
| Magnesite, calc, ton. | 40.00 – | 40.00 – | 40.00 – |
| Pumice stone, lump, bbl., lb. | .05 – .07 | .05 – .08 | .05 – .07 |
| Imported, casks, lb. | .03 – .40 | .03 – .40 | .03 – .35 |
| Rosin, H., bbl. | 3.65 – | 3.80 – | 4.15 – |
| Turpentine, gal. | .42½– | .44½– | .35½– |
| Shellac, orange, fine, bags, lb. | .20 – .25 | .20 – .25 | .38 – .40 |
| Bleached, bonedry, bags, lb. | .16 – .17 | .15½– .16 | .28 – .30 |
| T. N. bags, lb. | .09½– .10 | .08½– .10 | .16 – .17 |
| Soapstone (f.o.b. Vt.), bags, ton | 10.00 –12.00 | 10.00 –12.00 | 10.00 –12.00 |
| Talc, 200 mesh (f.o.b. Vt.), ton. | 8.00 – 8.50 | 8.00 – 8.50 | 9.50 – |
| 300 mesh (f.o.b. Ga.), ton. | 7.50 –10.00 | 7.50 –10.00 | 7.50 –11.00 |
| 225 mesh (f.o.b. N. Y.), ton. | 13.75 – | 13.75 – | 3.75 – |
| Wax, Bayberry, bbl., lb. | .16 – .20 | .16 – .20 | .19½– .22 |
| Beeswax, ref., light, lb. | .25 – .27 | .25 – .27 | .26 – .27 |
| Candelilla, bags, lb. | .11 – | .11 – | .14 – .15 |
| Carnuba, No. 1, bags, lb. | .21 – .23 | .21 – .23 | .29 – .30 |
| Paraffine, crude 105-110 m.p., lb. | .03½– .03¾ | .03½– .04¼ | .03½– .03¾ |

## Price Changes During Month

| Advanced | Declined |
|---|---|
| Ammonium sulphate | Cream of tartar |
| Red lead | Linseed oil |
| Litharge | English vermilion |
| Coconut oil | Rosin |
| Cottonseed oil | Turpentine |
| Corn oil | Mercury |
| Peanut oil | |
| Tallow | |

## Ferro-Alloys

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Ferrotitanium, 15-18%, ton. | $200.00– | $200.00– | $200.00– |
| Ferromanganese, 78-82%, ton. | 68.00– | 68.00– | 80.00–85.00 |
| Ferrochrome, 65-70%. | .10– | .10– | .11– |
| Spiegeleisen, 19-21% ton. | 25.00– | 27.00– | 30.00– |
| Ferrosilicon, 14-17%, ton. | 31.00– | 31.00– | 39.00– |
| Ferrotungsten, 70-80% lb. | 1.00– 1.10 | 1.00– 1.10 | 1.00– 1.10 |
| Ferrovanadium, 30-40%, lb. | 3.05– 3.40 | 3.05– 3.40 | 3.15– 3.50 |

## Non-Ferrous Metals

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Copper, electrolytic, lb. | $0.05⅛– | $0.05⅛– | $0.07⅛– |
| Aluminum, 96-99%, lb. | .229– | .233– | .233– |
| Antimony, Chin. and Jap., lb. | .05 – | .05 – | .0665– |
| Nickel, 99%, lb. | .35 – | .35 – | .35 – |
| Monel metal blocks, lb. | .28 – | .28 – | .28 – |
| Tin, 5-ton lots, Straits, lb. | .21½– | .21½– | .244– |
| Lead, New York, spot, lb. | .031– | .027– | .044– |
| Zinc, New York, spot, lb. | .0312– | .0295– | .0385– |
| Silver, commercial, oz. | .28⅛– | .26½– | .27⅛– |
| Cadmium, lb. | .55 – | .55 – | .55 – |
| Bismuth, ton lots, lb. | .85 – | .85 – | 1.50 – |
| Cobalt, lb. | 2.50 – | 2.50 – | 2.50 – |
| Magnesium, ingots, 99%, lb. | .30 – | .30 – | .48 – |
| Platinum, ref., oz. | 35.00 – | 35.00 – | 40.00 – |
| Palladium, ref., oz. | 18.00 – 19.00 | 19.00 – 21.00 | 19.00 – 21.00 |
| Mercury, flask, 75 lb. | 48.50 – | 56.00 – | 82.00 – |
| Tungsten powder, lb. | 1.45 – | 1.45 – | 1.65 – |

## Ores and Semi-finished Products

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Bauxite, crushed, wks., ton. | $6.50 –$8.25 | $6.50 –$8.25 | $6.50 –$8.25 |
| Chrome ore, c. f, post, ton. | 16.50 –19.00 | 17.00 –20.00 | 19.50 –24.00 |
| Coke, fdry., f.o b. ovens, ton. | 3.25 – 3.75 | 3.25 – 3.75 | 2.75 – 2.85 |
| Fluorspar, gravel, f.o.b. Il., ton. | 17.25 –20.00 | 17.25 –20.00 | 17.25 –20.00 |
| Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit. | .23 – | .25 – .26 | .25 – .27 |
| Molybdenite, 85% $MoS_2$ per lb. $MoS_2$, N. Y., lb. | .45 – | .45 – | .35 – .40 |
| Monazite, 6% of $ThO_2$, ton. | 60.00 – | 60.00 – | 60.00 – |
| Pyrites, Span. fines, c.i.f., unit. | .13 – | .13 – | .13 – |
| Rutile, 94-96% $TiO_2$, lb. | .10 – .11 | .10 – .11 | .10 – .11 |
| Tungsten, scheelite, 60% $WO_3$ and over, unit. | 9.00 –10.50 | 9.50 –10.50 | 11.50 –12.00 |

# INDUSTRIAL NOTES

CONSOLIDATED PRODUCTS COMPANY, dealer in used machinery and equipment, has moved its offices into new quarters at 15 Park Row, New York.

MAGNETIC MANUFACTURING COMPANY, Milwaukee, Wis., has appointed the Lindrooth, Schubart & Co., Boston Building, Denver, Colo., as a representative.

STEPHENS-ADAMSON MFG. COMPANY, Aurora, Ill., has established a new branch office in the Cutler Building, Rochester, N. Y., under F. H. Wisewell for sales and engineering service.

BABCOCK & WILCOX COMPANY, New York, has entered a contract with the U. S. Department of Interior for pipe and tunnel work at Hoover Dam and will erect a complete fabricating plant on the site of the work because of inadequate transportation means for the size of work to be constructed.

COSMOS CORPORATION, 36 Clifton St., Newark, N. J., has been incorporated to manufacture and sell a new type of ultra-violet lamp.

WORTHINGTON PUMP & MACHINERY CORP., Harrison, N. J., will transfer and consolidate the engineering and manufacturing activities formerly carried on at Cincinnati with the Buffalo, N. Y., manufacturing plant. The district sales office at Cincinnati under Mr. E. Vinnedge will remain.

MASON REGULATOR COMPANY, Boston, has appointed as a representative the O'Brien Steam Specialties Co., which has offices in Syracuse, Rochester, and Niagara Falls, N. Y.

PATTERSON FOUNDRY & MACHINE CO., East Liverpool, Ohio, has added E. M. Underwood to its staff as sales engineer in the company's headquarters.

MERCO-NORDSTROM VALVE CO., Pittsburgh, Pa., and WALWORTH CO. have terminated their patent suit and made a cross-licensing arrangement for mutual use of patents. The former company is a subsidiary of the Pittsburgh Equitable Meter Co.

ROBINS CONVEYING BELT COMPANY, New York City, has opened new sales offices at Cleveland, under R. Wisely, 229 Rockefeller Building, at Detroit under M. S. Lambert, 16170 La Salle Blvd., at St. Louis under H. J. Martini, 7146 Dartmouth Ave., and at Charleston, W. Va., under R. U. Jackson, 905 Edgewood Ave.

DINGS MAGNETIC SEPARATOR CO., Milwaukee, has appointed T. E. Cocker as district manager at 85 High Park Blvd., Buffalo, N. Y.

# NEW CONSTRUCTION

### Where Plants Are Being Built in Process Industries

| | This Month | | Year to Date | |
|---|---|---|---|---|
| | Proposed Work and Bids | Contracts Awarded | Proposed Work and Bids | Contracts Awarded |
| New England | $245,000 | ..... | $1,370,000 | $220,000 |
| Middle Atlantic | 210,000 | $500,000 | 2,590,000 | 4,990,000 |
| Southern | 100,000 | 7,000 | 1,355,000 | 494,000 |
| Middle West | 176,000 | 69,000 | 1,328,000 | 2,034,000 |
| West of Mississippi | 215,000 | 120,000 | 15,957,000 | 1,355,000 |
| Far West | ..... | 61,000 | 2,165,000 | 551,000 |
| Canada | 360,000 | 45,000 | 9,480,000 | 5,615,000 |
| Total | $1,306,000 | $802,000 | $34,245,000 | $15,259,000 |

## PROPOSED WORK BIDS ASKED

**Animal Husbandry**—A. & M. College, Prof. E. E. Giesecke, Archt., College Station, Tex., will soon award the contract for the construction of a 2 story animal husbandry building. Estimated cost $250,000.

**Brake Lining Plant**—Canadian Raybestos Co., Perry St., Peterborough, Ont., is having plans prepared for 1 and 2 story, 60 x 150 ft. and 35 x 60 ft. addition to plant for manufacture of brake linings. Estimated cost $45,000. John Hornsby, 332½ George St., Peterborough, is architect.

**Dry Cleaning Plant**—Medford Family Laundry, c/o E. G. Henline, Medford, Wis., is receiving bids for equipment and machinery for new dry cleaning plant. G. A. Krasin, Marshfield, Wis., is engineer.

**Dye Works**—Perth Dye Works, 482 Portage Ave., Winnipeg, Man., plans to build a 2 story addition to its plant on Good St. E. Prain, Confederation Life Bldg., Winnipeg, is architect.

**Dyehouse**—Hockanum Mills Co., Rockville, Conn., is having plans prepared for an addition to its dyehouse. Estimated cost $30,000.

**Chemical Plant** — Indian Rock Lime Co., Indian Rock, Va., (Botetourt County), L. P. Dillon, Pres., will open quarry and install plant for the production of chemical and hydrated lime products. Initial expenditure will be about $100,000.

**Chemical Plant**—Pfister Chemical Co., Inc., c/o C. T. Lansing, 67 North Dean St., Englewood, N. J., plans to construct a 2 story chemical manufacturing plant opposite Morsemere R.R. station, Ridgefield, N. J. Estimated cost $40,000.

**Chemical Plant**—Pharma Chemical Co., 169 West 52nd St., Bayonne, N. J., plans to rebuild its chemical plant recently destroyed by fire. Estimated cost $40,000.

**Explosives Plant**—Hercules Powder Co., Inc., Wilmington, Del., plans to install new boilers and modern power equipment and construct additional power housing facilities at its plant at Kenvil, N. J. Estimated cost $135,000. George E. Ramer is chief engineer.

**Dry Kiln** — Union Shingle Mill Co. Ltd., Mitchell Island, B. C., plans to construct dry kiln and storage sheds. Estimated cost $35,000. J. A. McKercher is manager.

**Gas Plant**—Magnolia Petroleum Co., Magnolia Bldg., Dallas, Tex., plans to construct a carbon black residue casinghead gas plant in Wheeler County, Tex. Exact location not yet decided on. Estimated cost $150,000.

**Glass Plant** — Capstan Glass Co., L. P. Piazzoli, Engr., South Connellsville, Pa., will build a 1 story, 60 x 60 ft. addition to its pant for the manufacture of glass food containers. Austin Co., Union Trust Bldg., Pittsburgh, is engineer.

**Laboratory and Gas Plant**—U. S. War Dept., Lieut. Col. John A. Paegelow, Commander, Scott Field Lighter-Than-Air-Base, Belleville, Ill., plans to construct photographic laboratory and gas plant at Scott Field Air Base. Estimated cost $36,000 and $50,000 respectively.

**Laboratory** — Board of Chosen Freeholders, Court House, Jersey City, N. J., will receive bids about Sept. 25 for a 2 story laboratory at Laurel Hill, Secaucus, N. J. Frank J. Radigan, 591 Summit Ave., Jersey City, is engineer and architect. Estimated cost $40,000.

**Leather Factory**—J. S. Barnet & Son, 128 Boston St., Lynn, Mass., will soon receive bids for a 3 story factory on Boston St. to replace one destroyed by fire. New machinery will be required. Private plans. Estimated cost including machinery $40,000.

**Leather Warehouse**—Owner, c/o F. T. Hogg and W. E. Campbell, Archts., 45 Newbury St., Boston, Mass., will soon receive bids for rebuilding warehouse at Beach and South Sts., Boston, recently destroyed by fire. Estimated cost $150,000.

**Oil Dispensary System** — Treasury Dept., Wash., D. C., will soon receive bids for gasoline and refined oil dispensary system at Randolph Field, Scherts, Tex. Estimated cost $25,000.

**Oil Distributing Plant**—The Home Fuel Oil Co., W. G. Moore, Mgr., 18 West Palisade Ave., Englewood, N. J., plans to construct an oil distributing plant on Brinckerhoff St., north of Forest Ave., Englewood. Estimated cost $60,000.

**Oil Storage Tanks** — Bridgeport Stone Co., Frank E. Clark, Owner, 1106 North Ave., Bridgeport, Conn., is having plans prepared for nine oil storage tanks having capacity of 450,000 gal. at Hamilton and Hallam Sts.

**Refinery**—Direct Oil Refineries Ltd., Higgins Ave., Winnipeg, Man., plans to construct a refinery on Raleigh St. and will be in the market for equipment. Estimated cost $50,000.

**Refinery**—Transport Oil Co., Inc., C. P. Ritter, Pres., 25th St., Long Beach, Calif., plans to construct an oil refinery at Baca, N. M., to have daily capacity of 1,200 bbls.

**Paper Factory**—DePere Paper Manufacturing Co., c/o Herman Miller, 415 South Van Buren St., Green Bay, Wis., plans to construct a paper manufacturing factory. Estimated cost $50,000. W. E. Reynolds, 113 South Roosevelt St., Green Bay, is architect.

**Sulphide Dioxide Plant** — **Canadian Industries, Ltd.**, 1050 Beaver Hall Hill, Montreal, Que., plans to construct a sulphide dioxide plant. Estimated cost $200,000.

**Tallow Plant**—Louis Stern's Sons, Inc., 4th St. and Hackensack River, Kearny, N. J., plans to rebuild plant on 4th St. recently destroyed by fire. Estimated cost $40,000.

## CONTRACTS AWARDED

**Alumina Sulphate**—City, W. E. MacDonald, Engr., City Hall, Ottawa, Ont., awarded contracts for sulphite of alumina to General Supply Co. of Canada, Ottawa, and Wright Builders Supply Co., Ltd., Ottawa, 300 tons each, at $25 per ton.

**Fibre and Bakelite Plant**—Taylor & Co., Inc. (formerly Diamond State Fibre Co.), Provident Trust Bldg., Philadelphia, Pa., is building a plant for the manufacture of vulcanized fibre and laminated bakelite or synthetic resin products at Betzwood, near Norristown, Pa. First unit to consist of 100 x 700 ft. building equipped with modern machinery, most of which is special. Estimated cost of first unit $500,000.

**Glass Factory** — Fairmount Glass Co., 1601 South Keystone Ave., Indianapolis, Ind., will build a 1 story, 57 x 160 ft. factory by day labor. Estimated cost $29,000.

**Gas Plant**—British Columbia Electric Power & Gas Co., Ltd., Vancouver, B. C., awarded contract for carbonizing plant in connection with new gas plant development at False Creek to Adkinson & Dill, Ltd., 319 West Pender St., Vancouver; exhauster house and office and mess buildings to Harvie & Simmonds, Ltd., 500 Beatty St., Vancouver. Estimated cost $44,488.

**Gas Storage Containers**—Southern Counties Gas Co., 810 South Flower St., Los Angeles, Calif., awarded contract for four steel gas storage containers at Santa Fe Springs and Whittier Rd., Whittier, Calif., to Chicago Bridge & Iron Works, 523 West 6th St., Los Angeles. Estimated cost $61,000.

**Laboratory** — Virginia Polytechnic Institute, Blacksburg, Va., awarded contract for completion of chemical laboratory of Davidson Hall to R. K. Stewart & Sons, High Point, N. C. Estimated cost $60,000.

**Laboratory Buildings**—A. & M. College, College Station, Tex., awarded contract for 4 story, 57 x 186 ft. petroleum engineering and geology building to Henger & Chambers, Dallas Natl. Bank Bldg., Dallas; two units of veterinary hospital and 2 story, 42 x 72 ft. dissecting laboratory to E. Weiland, San Antonio.

**Magazine Buildings** — Constructing Quartermaster, Maxwell Field, Montgomery, Ala., awarded contract for construction and completion of seven standard magazines at Maxwell Field, to Samford Bros., Montgomery. Estimated cost $6,980.

**Pottery Plant**—S. S. Kresge Co., Kresge Bldg., Detroit, Mich., awarded contract for a 1 story pottery plant at Mt. Clemens, Mich., to Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $40,000.

**Refinery**—Humble Oil & Refining Co., Corpus Christi, Tex., plans to improve and enlarge its refinery at Ingleside, including new equipment, stills, etc. Work will probaby be done by company forces.

**Refinery**—Shell Oil Co. of British Columbia, 559 East 5th St., Vancouver, B. C., awarded contract for clearing site for wharf at proposed refinery at Burrard Inlet to Westminster Construction Co.; wharf, to Pacific Engineers, Ltd., 1044 Beach Ave., Vancouver. W. N. Thompson, c/o Shell Oil Co. of San Francisco, San Francisco, Calif., is engineer. Estimated total cost of refinery $1,000,000.

**Refinery**—Sheridan Oil & Refining Co., E. L. Newbury, Pres., Sheridan, Wyo., is building a 100 bbl. oil refinery by day labor. Estimated cost $20,000.

**Refinery**—George F. Dickey, Union Natl. Bank Bldg., Wichita, Kan., is interested in company being formed to construct an oil refinery and processing plant at McPherson, Kan. Work will be done by local labor under supervision of Roy Miller, Wichita, Kan. Estimated cost $50,000.